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ABSTRACT

Summarizing the final phase of a two-year project that examined the processes by which children initially approach the reading task, this report presents both general and individual findings derived from the analyses of the children's performance over the course of a year. The first section discusses the following general topics related to the children's performance: the accuracy of decoding and encoding, the difficulties associated with processing vowels, the effects of additional information on accuracy, the function of meaning in the early phases of decoding and encoding, and the nature of the strategies that the children developed for each task. The second section of the report relates detailed information on each of the four children who participated in the project. For three of the children, on whom maximum data were available, the following information is presented: pretest performance and characteristic behavior in the instructional sessions; the accuracy of decoding and encoding consonants, vowels, and whole words; positional and orientation confusions; the effect of overt segmentation and letter naming on reading accuracy; evidence of emerging or changing strategies; the effects of meaning; and the relative success of reading strategies. Tables are included. (MAI)

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Final Report

Phase II

Early Decoding and Encoding Strategies Project

August 1977

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INTRODUCTION

In April, 1977, the project staff submitted a preliminary report which described the procedures followed during the 1976-1977 year. The present report does not repeat the material presented earlier but rather addresses the substantive questions upon which the project focussed.

The report is divided into two sections. The first provides a summary and discussion of the general findings from the analyses of the children's performance over the course of the year. The second section includes a separate report on each individual child's performance, and includes a description of the child and his/her approach to the reading task, a quantitative analysis of various aspects of performance (this is available for only four of the children, see below for an explanation) and a discussion of the unique patterns and strategies exhibited by the particular child. Following a brief description of the children in the study, the first section is organized around the following topics:

1. Accuracy of decoding and encoding: The children's processing of grapho-phonemic information related to instructional mode.
    a. The difficulties associated with processing vowels.
    b. The effects of additional information on accuracy.
2. The function of meaning in the early phases of decoding and encoding.
3. The unique characteristics of the decoding and encoding processes and the nature of the strategies that the children developed for each task.

For each of these topics findings from the reports on the individual children are summarized, related to each other and their meaning and implications for research and/or education discussed.

The individual reports vary in format from child to child and differ considerably in the amount of detailed information presented and in the kinds of analyses which were possible. For three of the children, on whom maximum data were available, the reports follow a relatively consistent order of presentation covering the following topics:

1. Pretest performance and characteristic behavior in the instructional sessions.
2. Accuracy of decoding and encoding consonants, vowels and whole words (mainly of the CVC configuration).
3. Positional and orientation confusions.
4. The use of overt segmentation and/or letter naming and their effects on accuracy in decoding and encoding.
5. Evidence of emerging or changing strategies.
6. The effects of meaning of the materials.
6. Relative success in decoding and encoding.

SECTION I

The material covered in this section is derived from the analyses and descriptions of the individual children. The major part of each section focuses on the performance of the three children (described below) whose progress in the course of the year allowed for detailed assessments.

The Children in the Study

Six children were involved in the study during the 1976-1977 academic year. They were selected from a pool of 46 children who had taken the screening test developed by the project staff. On the basis of an evaluation of their scores on this test, two of the six children were assigned to the part-to-whole (P-W) method, two to a whole-to-part (W-P) method and two to a mixed method (MM). However, one of the children in the MM mode had already developed a reading strategy which was not apparent on the pretest since it operated effectively only on material presented in context, which the test did not include. The other child in the MM evidenced great difficulty both in retaining whole word information and in blending. His learning problems precluded pursuit of the planned curriculum and his performance yielded little systematic information. It was, therefore, not possible to assess the effects of the mixed method on the development of pupil strategies. Still another child, this one in the P-W mode, was unable to follow the planned curriculum. Thus, only three children's progress could be analyzed in detail--two in W-P and one in P-W. The report includes detailed studies of the performance of the three children and narrative summaries of the progress of the remaining three.

Content and Form of the Individual Analyses

Most of the analyses are based on the children's responses to "generalizing words"--words presented for decoding or encoding for the first time. However, performance on "taught" material was also examined where appropriate. Since most of the words with which the children dealt were of the CVC form, the basic analyses were performed on such trigrams. In some cases, a child's handling of other word forms was also analyzed. In order to assess changes in response patterns over time, the sessions were clustered into periods and each period analyzed separately. In two cases, a period was defined by the introduction of a new vowel, in another, by a particular "break-through" behavior evidenced by the child and in still another case (one for which only a descriptive analysis is presented) by a special intervention procedure. These are described in the individual reports.

The individual reports for each of the children appear in Section II. What follows is a presentation of some of the general findings listed above and a discussion of their meanings and implications.

Accuracy in Decoding and Encoding

Relative Difficulty of Consonants and Vowels

Despite the fact that the children were exposed to many more consonants (ten or more) than vowels (no more than four), they were consistently more accurate in dealing with consonants. This was true regardless of instructional mode and regardless of the level of accuracy which the child reached. K, who was in the W-P mode, showed some confusion in decoding consonants, especially after the introduction of the second set. Nevertheless, he reached about 80 per cent accuracy in the last period on consonants in both first and last position. In contrast, his accuracy rate on /a/, the first vowel introduced, never went above 60 per cent, and for the /ω/ and /e/, introduced in the last period, he was accurate only 22 and 50 per cent of the time, respectively. Although he read the i correctly 88 per cent of the time, this reflected a tendency to produce the /i/ whether it was appropriate or not.

M, also in the W-P mode, likewise had more difficulty with vowels than with consonants. In the last period, he decoded both the initial and final consonants of CVC generalizing words with almost 100% accuracy, but only achieved 55% accuracy for the medial vowels. The only vowels on which he achieved errorless performance in the last period was the /a/. The /i/ never went beyond 55 per cent and the /ω/ 44 per cent accuracy, respectively. (The _e_ appeared in only four words and was never correct.)

A, who was in the P-W mode and had been taught each of the vowels as a separate phoneme, did relatively better than the W-P children. She decoded CVC words with about 85 per cent accuracy for the consonants and 77 per cent accuracy on the medial vowel. But when the vowel appeared at the end of a trigram (CCV), she decoded the first and second consonant with 89 and 100 per cent accuracy, respectively, but responded correctly to the final vowel only 33 per cent of the time.

The unique problems inherent in correct vowel decoding became most clearly apparent in observing KM's performance. KM read quite fluently in context and generally produced the appropriate vowel sounds when the context dictated what the word should be. But, when confronted by words in isolation, she regularly made vowel errors either of substitution or omission. Out of a total of 92 errors made in decoding CVC words in isolation, 50 or 54% involved only a vowel error.

The picture for encoding was only slightly different. K, for example, who encoded consonants with 78 per cent accuracy, reached 80 to 100 per cent accuracy on the /a/, /ω/, and /e/. Only the /i/ gave him much trouble, reaching about 75 per cent accuracy in the last period. But M, whose consonant encoding reached 90 per cent, encoded the vowels with only 78 per cent accuracy and A showed about 95 per cent accuracy for consonants while only 72 per cent of her vowels were encoded correctly. KM also had more difficulty with vowels, frequently omitting the vowel altogether or substituting an incorrect letter.

Explaining Vowel Difficulty

Although there is probably no one reason for the difficulty beginning readers have with vowels, several explanations need to be explored.

Salience. In general, the major part of the meaning of a word is carried by the consonants. Examination of speed writing techniques indicates how readily vowels may be omitted and the message still carried. In verbs, especially in those which are most common in the languages and appear most frequently in children's readers, often act only as tense markers (sit-sat; giv-gaev), an aspect of language which does not have high salience for young children. In many words, the schwa following the consonant acts as a vowel and the child sees no need to put in another vowel when encoding (ht for hat, or tp for tip). Especially when reading in context, as in the case of KM, knowledge of the consonant sounds, plus the "sense" of the discourse as signalled by semantic and syntactic context cues, produce sufficient information to make sense of the printed page.

Isolating vowels as phonemes. A further problem relates to the acoustic properties of phonemes. Spectrographic analyses show that people do not hear isolated phonemes. What is heard is at least a syllable.[1] Actually, then, the vowel acts as a modifier of the consonants rather than as an independent entity and may be difficult to break out of a syllable in encoding or to attend to separately in decoding.

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[1] Liberman, A.M. The Specialization of the language hemisphere. In B. Milner, (Ed.), Hemispheric specialization and interaction. Cambridge, Mass.: MIT Press, 1975.

Relation of sound to letter name. Since most of the children tested for the project knew the English names for many of the alphabetic graphemes, this knowledge may have acted to facilitate consonant identification but impede the accuracy of dealing with the short vowels. The names of many of the English consonants begin with the sound which the letter carries in writing (b, d, j, k, p, etc.). Others, although beginning with a vowel, end with the consonant sound which distinguishes them from each other in name (f, l, m, n, s, etc.). That this is salient information for young children is seen in the frequent identification of the sound of w as /d/ and of y as /w/. The English names of the vowels, however, have the sound of the long vowels, which bears no relationship to the sound of the short vowel. Especially when children interpose the letter name in moving from the grapheme to the sound equivalent, they receive a false cue to the vowel sound but an appropriate cue to most of the consonant sounds.

All of the above hypotheses need further testing before their relative contributions to explaining vowel difficulty can be ascertained. Nevertheless, two implications warrant consideration:

1. In his spectrographic analyses of CVC trigrams, Liberman (1975) states: "There is no part of the sound that contains information about only one phonemic segment. At every point, the sound is carrying information simultaneously about at least two successive segments (CV or VC) of the message....It is as if the initial and final consonants...had been folded into the vowel..." (p. 48).

If, indeed, single phonemes are not acoustically discernable, as Liberman suggests, then teaching individual grapheme-phoneme correspondences may not be the best approach. This would be especially true in a P-W method where instruction on syllables rather than single phonemes might improve accuracy. The issue is not as relevant to the W-P mode which leaves children free to arrive at any segmentation strategy which they find most effective. Where the teaching of reading combines both whole word presentations and instruction in grapheme-phoneme correspondences (currently a common method of instruction), children might well be left to discern the consonant sounds from the words they are taught, but should probably receive vowel instruction through learning bigrams which associate vowel sounds with known consonants both in CV and VC configurations.

2. Most children are currently exposed to the names of the letters of the alphabet before beginning formal reading instruction through watching Sesame Street or through kindergarten pre-reading programs. It may, therefore, be desirable to make a deliberate effort to teach children an alternate set of names for the vowels. This is especially important when using ita, where none of the vowel graphemes are labelled by the traditional letter names which the children already know. As noted above, the children frequently interposed letter names between the auditory stimulus and their encoding efforts, as if the label provided them with a clue to finding the appropriate letter. This worked well for the consonants. But the children had no clue for finding the letter _i_ from the sound /i/. One cannot unteach the letter names; nor should one. But, like people, letters can have more than one name and two people can have the same name. Thus, the symbols i and I, known to the children to bear the name /ie/ can also be called /i/; and, although the symbols a or A are called /ae/, the same name can be given to the symbol ae. Children will probably accept the alternate set of names if they are explicitly informed that these names will be used in their reading instruction.

The Effects of Adding Information on Accuracy

All of the children were initially presented with the same phono-graphemes, whether as independent sound-symbol correspondences (P-W) or in whole words. The first unit included the vowel *a* and the consonants *p*, *m*, *s*, *t*, *n*, and *d*. During this first period, which lasted from one to two and a half months, depending upon the child's learning pace, the children's decoding responses to generalizing words of the CVC configuration showed a relatively high error rate to the vowel and to most of the consonants. For example, A gave the appropriate /a/ sound for *a* only 65 per cent of the time and for the six consonants from 50 per cent for *s* to 100 per cent for *n*, which was introduced last in this unit. M responded correctly to *a* 43 per cent of the time and to the consonants from 0 per cent for *d* to a high of 40 per cent for *m* with an average accuracy of about 16 per cent. K responded correctly to *a* 44 per cent of the time, and to the six consonants from a high of 69 per cent for *s* to a low of 31 per cent for d.

The introduction of new material only rarely interfered with performance on the old material. In fact, for A, the correct production of the /a/ went from 65 to 73 to 67 and finally to 100 per cent accuracy during the periods following the introduction of *i*, _ , and *e*, respectively. M's accuracy for a went from 43 to 67 to 100 per cent as the other vowels were introduced, and K went from 41 to 56 to 60 per cent accuracy.

Decoding. To examine the effects of the introduction of new consonants on the accuracy of decoding an encoding the first six consonants to which the children had been exposed, the children's performance was divided into two phases: 1) the sessions during which they dealt only with the first six consonants and 2) the remaining sessions, after the introduction of additional consonants.

In general, the introduction of new consonants did not interfere with the accuracy of decoding or encoding the original group of six. A's accuracy increased considerably on four of the six original consonants going from 50 to 90 correct per cent for s, 75 to 83 per cent for t, 50 to 91 per cent for m, and 60 to 89 per cent for d. She showed a slight drop in accuracy for n (from 100 to 88 per cent) but this may have reflected a five fold increase in the number of words which involved this consonant (from 3 words in the first phase to 16 in the second). But her accuracy in decoding p dropped from 86 to only 70 per cent. This drop did reflect interference from new material since all her p errors involved the substitution of /b/, and vice versa, after the b was introduced. This particular confusion may be either a visual up-down confusion or an articulatory confusion (since /b/ and /p/ are the voiced and voiceless forms of the same essential sound), or both.

M showed a startling improvement between phases 1 and 2. His accuracy increased from 17 to 88 per cent on s, from 40 to 100 per cent on m, from 9 to 100 per cent on p, from 13 to 92 per cent on t, from 17 to 100 per cent on n and from 0 to 71 per cent on d. This change reflected M's evolvement of a decoding strategy at the same time as new consonants were introduced.

K showed a more variable pattern in his accuracy. While going from 43 and 50 to 100 per cent accuracy on s and p, respectively, and moving from 0 to 57 per cent on d, he improved only moderately on n (40 to 57 per cent) and on the m and t his accuracy dropped from 64 to 50 per cent and from 64 to 36 per cent, respectively. It is difficult to account for K's variable performance. His performance gave no evidence of any particular confusions and there is no apparent reason why m or t, to which he responded with the highest accuracy initially, should have become a source of error when additional consonants were introduced.

Another question relates to the level of accuracy that the children achieved on the second set of consonants which they met for the first time in phase 2. Higher accuracy on the second group than on the first would strongly suggest that the children had developed a strategy for dealing with consonants and did not need extensive practice to achieve a high level of accuracy. This was indeed the case for M. From the moment any new consonant was introduced in phase 2, he responded to it with 100 per cent accuracy. A showed a similar pattern but her general accuracy was somewhat lower. She confused the /b/ with the /p/ so that b was decoded accurately only 82 per cent of the time. The remaining six consonants which were introduced in phase 2 were decoded with 90 to 100 per cent accuracy from the start, without requiring any time for practice. K once again showed a variable pattern. Because he performed so well on the words he was taught, some new consonants were introduced before he had evolved any sort of strategy for decoding new material. His accuracy on r and c, the first two new consonants he met, were decoded with 63 and 40 per cent accuracy, a level similar to the one achieved for the consonants in phase 1. He did better on l (73 per cent correct responses) which came at about the same time. But from 3/29 on, when he began using segmentation consistently in his encoding, his accuracy for decoding the consonants introduced from then on was either 100 per cent (for f, k, b and h) or 67 per cent (for Sh).

In general, the introduction of new consonants did not lower the accuracy of those learned earlier. Accuracy increased for the old consonants not as a function of dealing with a larger set of materials, but rather as a function of the evolvement of a more or less effective strategy for decoding. In M's case, where the introduction of new consonants coincided with the development of a general strategy, all consonants, old and new, were decoded with almost perfect accuracy. In K's case, where he confronted new consonants before he had a general strategy available, he decoded them about as accurately as he had originally decoded the first set.

Encoding. Changes in encoding accuracy did not show as clear a pattern. A, who "hated" encoding and frequently refused to engage in the task, performed with 100 per cent accuracy on all but one of the consonants in the inital phase. She had trouble with d and encoded it correctly only 40 per cent of the time. But these percentages are based on very few words. The only consonant which she had to encode more than three times during the first phase was d (5 words) which was indeed prone to considerable error. In the second phase, where she had a few more words for each of the old consonants, she dropped to 80 per cent accuracy on s and t, but encoded the rest correctly each time. Even the d reached 100 per cent accuracy. Her encoding of the new set of consonants in the few words in which each appeared was almost completely correct.

M, whose encoding was superior to his decoding from the very beginning, originally encoded the first six consonants with an average accuracy of about 70 per cent--from 50 per cent for p and d to 100 per cent for n. After the new consonants were introduced (from 3/16 on) his encoding accuracy improved on the original set. On m, t and n, he was correct 100% of the time; on p, d and s, he made only one error. The consonants introduced in phase 2 were used either with perfect accuracy or with one error. Only in encoding /l/ did he make two mistakes. For M, the change in encoding after he had evolved a strategy was not as dramatic as it was in decoding. In fact, he found the encoding task easier from the beginning to the end of the year.

K had considerable trouble encoding in phase 1. Only the /l/ was encoded with relatively high accuracy (80 per cent). The remaining four consonants ranged in correct responses from 0 to d for 57 per cent for s. In the second phase he showed more or less improvement on all but the n, where his accuracy dropped from 80 to 50 per cent. But the beginnings of a breakthrough are visible in the 83 and 86 per cent accuracy achieved on s and m, respectively, the two consonants in his "teaching" word "sam," on which he first tested out a segmentation strategy. In phase 2, consonants introduced before 3/29 were dealt with at about the same level of correct responses as was apparent in the original set. But for consonants introduced from 3/29 on, when his encoding strategy was working effectively, he reached 100 per cent accuracy, except for one error on Sh.

Implications

The evidence from the project children strongly suggests that accuracy of decoding and encoding is not a function of overlearning the components. It is not simply a rote memory process since the addition of new material does not interfere with the accuracy of dealing with previously learned material. When the introduction of new material coincides with the child's evolvement of a strategy, then it is used accurately almost at once and the old material is now also dealt with effectively. When new material is presented before the child has evolved a general strategy, it is dealt with at about the same rate of accuracy as the earlier set.

For children who are still floundering and have not evolved an effective approach, new material, at least up to a point, neither harms nor helps. It may be useful in order to give the child greater variety and keep him/her interested in the task. But in such cases, new material should be introduced a little at a time to avoid possible information overload. However, once the child has evolved a strategy, then he/she can integrate with a great deal of new material--as much as he/she can learn to discriminate visually and auditorily.

These generalizations apply more to consonants than to vowels since even after evolving highly effective strategies for decoding and encoding consonants, children still suffer from vowel confusions. But here, too, it is not a question of overload--the children made relatively as many errors when they had had only two vowels as when they had four. Accuracy in the use of the vowel seems to depend more on the children's recognition of the importance of attending to the vowel, their ability to isolate it as an independent entity or as part of a syllable, as well as their memory for the relatively subtle auditory distinctions among the vowel sounds.

The Function of Meaning in Decoding and Encoding

In the first phase of the project (1975-1976) it appeared as if at least three of the four children wanted their reading to "make sense." This impression was gained from comments made by some of the children and by the tendency to extend apparently meaningless words into those which had meaning for the child (cab to cabbage; tac to tackle).

During the current year it was possible to monitor the children's decoding responses to determine whether a) meaningul words were decoded with greater accuracy than those which had no meaning for the child, and b) whether the error responses to both kinds of stimulus words were more often meaningful than nonsense.

For encoding, only the question regarding greater accuracy for one or the other type of stimulus could be raised. It was not possible to deal with the nature of the responses since the child thought that what he/she had encoded was, indeed, the stimulus word and whether incorrect encoding resembled a meaningful word was largely a matter of chance.

In examination of the protocols, it was necessary to divide the decoding words into three categories: a) words which definitely had meaning for the child; b) words which were clearly nonsense; and c) words which have definite English meanings but which the children probably did not know so that they might appear to them to be meaningless (e.g., tot, mass, etc). This category of words was eliminated from the analyses.

Meaning in Decoding

In general, the accuracy in decoding the three types of words showed no consistent patterns. A decoded 65% of the meaningful words (53 out of 81) and 44% of the nonsense words (7 out of 16) correctly; M decoded with 30 per cent (12 out of 40) and 25 per cent (3 out of 12) accuracy, respectively, and K was accurate on 18 per cent of the meaningful words (10 out of 56) and 11 per cent of the nonsense words (1 out of 9). Since most of the stimulus words were meaningful, percentages for this category are more robust and reliable than for the far less frequently presented nonsense words.

For the W-P children (M and K), the presentation of a new whole word would provide no clue as to its meaning, unless the child was able to "figure it out." For A, in the P-W, meaning might have acted as a check on her sounding out. In fact, she did show somewhat greater accuracy for meaningful words.

The more interesting question relates to the nature of the children's errors. In general, the tendency to give a meaningful response was stronger than to respond with a nonsense word, regardless of the nature of the stimulus. A, M, and K, respectively, gave 61, 68, and 80 per cent meaningful error responses and only 39, 32, and 20 per cent nonsense error responses to meaningful stimuli. To nonsense stimuli, they gave 100, 80, and 67 per cent meaningful error responses and only 0, 20, and 33 per cent nonsense ones. Thus, the nature of the stimulus clearly had lttle effect on the nature of the errors that the children made.

The tendency to give a meaningful response may have been fostered by the preponderance of meaningful words in the total number to which the children were exposed. They may have developed an expectation that the unknown words, like the words which they were taught in the W-P mode or had figured out in the teaching context in the P-W mode, would also have meaning.

For KM, meaning was an essential clue. But she derived meaning from context rather than necessarily imposing it on words in isolation. But, even when misreading single words, she tended to make meaningful responses more often than nonsense ones.

It is interesting to note that A, for instance, who was taught by a P-W approach, depended little on "sense" when reading words in context. The errors she made were rarely syntactical, nor did she substitute similar appearing words to suit the semantic context. She read "sild" in the sentence "Bill *slid* on the mat," and "Ann ran *fat*" for "Ann ran fast," and for the sentence "The shω is blω," she read "The shω is *bill*." Because of her strong dependence on a "sounding out" strategy, she did not use context to help her make sense out of what she read.

Meaning in Encoding

As noted earlier, the child's encoding efforts are a representation of what he/she considers the correct response, regardless of how it appears to the adult. Therefore, no response analysis is possible. But one can assess the accuracy rate for encoding meaningful vs. meaningless stimulus words. Inspection of the children's performance suggests that the nature of the stimulus had no more effect on the accuracy of encoding than it had on decoding.

In both decoding and encoding, the meaningfulness of the words had no influence on accuracy. However, decoding errors significantly more often resulted in the production of a meaningful word. To what extent this tendency reflected the children's basic beliefs about the relationship between reading and spoken language and to what extent it was a function of a set created by the instructional materials is not possible to determine. However, if our hunch is correct that an understanding of the reading-language relationship is essential to the ready acquisition of reading skills, the performance of the four children for whom evidence is available indicates that they have this understanding. To what extent this helped them in evolving their decoding strategies is not clear. But the expectation that meaning will result from decoding may have provided them with a basis for verifying their responses, especially when reading in context, and correcting themselves when they produced a meaningless response.

Implications for Instruction

While it may be desirable to ask children to decode or encode nonsense words in order to check on the consistency of their skills, the use of such material may set up confusions if the child has an expectation that decoding of the printed symbols will produce comprehensible, meaningful language. It may therefore be worthwhile to employ separate modes of presentation when dealing with the two categories of stimulus materials: when the words are meaningful, to use the standard presentation form, when they are nonsense, to so inform the child. The latter can be put in the format of a special game so that the child becomes aware that, in this game, his expectation will be deliberately violated. Such a procedure was not used in the project because of our interest in the child's expectations. It is, therefore, not possible to predict how children will respond when they are told that the word is not "real" and whether their errors in response to nonsense words will more often be nonsense than was the case for the project children.

To the extent that, in the beginning phases before a firm strategy develops, children use meaning as a means of verifying the accuracy of their responses--and this may well be a desirable procedure--they may feel constrained to give a nonsense response, even if it is correct. For example, KM. in responding to "rŭn" said, "rŭn," corrected it to "rŭm" and then, after looking again, went back to "rŭn." In A's case, there were several examples of correct segmentation of a nonsense word followed either by an incorrect meaningful version as in "/p//a//p/--pop" when responding to "pap" or "/l//a//l/--owl" when responding to "lal," or by no whole word response as when she gave "/s//a//s/" to "sas" but would not give a word.

By informing children that they are confronting a word which "doesn't make sense," they would be freed to respond with a nonsense syllable without looking to meaning for verification. Above all, they would be less apt to view such words as a violation of their expectations. They could then continue to anticipate a meaningful result from their decoding efforts unless specifically told otherwise.

Evolving Strategies for Decoding and Encoding

In the first year of the project (1974-1975), encoding was initially viewed as one means of checking the child's knowledge of words. We operated on the assumption that if a child could really read a word, he/she could not only recognize it, but could also assemble it. It soon became clear that the two tasks involved quite different processes. One of the children, (J), not only assembled but actually wrote many words correctly which she could not decode; and, in general, the accuracy for the two tasks varied considerably from child to child. On the basis of those results, the procedures developed for this past year's work deliberately set out to make independent assessments of the accuracy of performance and the evolvement of strategies related to each of the two tasks and to compare them for each of the children.

Where instruction is by a part-to-whole method, the child is prepared to assign sounds to individual graphemes (or bigrams) and, theoretically, knows what the appropriate sound-symbol correspondences are. Blending these into a whole word may still pose problems, even for the child who has grasped the blending process. The problems result from the need to keep the first sound in mind as one moves to the second, and then keep two in mind, in the appropriate order, as one moves to the third, etc. This process may result in positional errors, where the child starts with the last, most recently decoded sound, as in reading "tim" as "mim" or "man" or even making a complete reversal and producing "mit." Or, the child may say a word beginning with the correct first letter and because he has "forgotten" the rest, say an incorrect word such as "man" for "mit" or "pim" for "pat." A frequently observed error is the omission of the least salient element, the vowel. When moving beyond trigrams, the process imposes an even greater memory load and, until the child develops some sort of chunking-recognition strategy, results in positional, substitution and omission errors.

For the children taught by a whole word method, still another step is involved. They have to infer the sound equivalents of individual (or CV/VC) visual symbols from their sounds in the whole word. Only then are they able to apply some segmentation strategy when confronted by new words and are then prone to the same errors discussed for the part-to-whole learners.

Encoding requires the child to move from an auditory whole word stimulus to the auditory segmentation of the sounds and then to finding or producing the appropriate symbols. However, there is no need to hold the several sound equivalents in mind since each sound can be encoded as it is recognized or produced orally. Children still make some positional errors if they first sound-out the entire word, and, indeed, sometimes leave out the vowel because it may be auditorialy equivalent to the schwa or simply not recognized as an independent unit.

But the task of finding or writing the appropriate symbol presents unique problems. As noted in an earlier discussion, most children identify the letters by the alphabetic names, which they already know, and, thus tend to transform the sounds into letter names which give them a label with which to determine which is the appropriate symbol. This procedure works better for consonants than for vowels even in ita if the children resort to known English letter names.

Clearly the two tasks involve different processes and call for different strategies. Decoding requires transforming a visual stimulus into an auditory response by means of a series of steps which impose a considerable memory load. Encoding requires transforming an auditory stimulus into auditory components and then identifying visual equivalents for each component in turn, without the requirement of retaining all the components in memory.

Accuracy of Decoding and Encoding CVC Components and Whole Words from Initial Period to Final Period

Examination of the decoding and encoding performance of the three children for whom detailed analyses are presented indicated great variations in accuracy and the use of segmentation from child to child. All three children showed considerable improvement over the five-month period in both decoding and encoding although the rate of improvement varied. However, the relative accuracy on the two tasks differed by child.

A's performance strategies and errors. A, who was in the P-W mode, started with the highest proportion of correct responses in both modes (41 and 54 per cent, respectively) and in the last period achieved 67 per cent accuracy in decoding and 64 per cent accuracy in encoding. Since she had learned the necessary sound-symbol correspondences and early evolved a segmentation-blending approach, she had the basic tools and the necessary strategy to attack new words in both tasks with almost equal success. Although she initially appeared to be somewhat more accurate in encoding, she actually encoded very few words because she "hated" the process and frequently refused to do it. As a result, she only encoded some 27 new words throughout the year as against decoding 128 new words. By the final period, A reached about 90% accuracy in decoding the two consonants and about 80% accuracy on the vowels in the CVC patterns and she almost always put the components in the correct position. Her errors included occasional omissions of vowels (reading "mt" for "mit") and in one or two instances failure to give any whole word response, even after correct segmentation of all components (saying /s//a//s/ and no more); she sometimes substituted an incorrect component for one she had segmented accurately (in response to "rib" saying "/r//i//b/, reb," in response to "kill" saying "/k//i//l/, kull," for "bell" saying "/b//e//l//l/, bill"). She missed the first consonant only once, substituting an f for the p in "pal." But she did make several errors on the final consonant, sometimes substituting t for d, d for t, ck for ss, k for g, and z for ss. For A, the first consonant was clearly the most salient and she tended to "forget" the last consonant as she formed the whole word. These types of errors were as apparent in the last period as in the earlier ones. However, of the 28 whole word errors which she made, 16 were due to using the wrong vowel.

In encoding, A initially tended to omit the vowel and later to use an incorrect vowel, generally substituting a for e. Only once she reversed the positions of the last two consonants and once she selected only the first letter and stopped. Thus, the major source of error in both tasks was the vowel and it continued to give her trouble to the very end.

The reason for her antipathy to the encoding task is not clear. It was not a function of excessive failure: she missed 30 per cent of the encoding words as against 37 per cent of the decoding words.

M's and K's performance strategies and errors. M and K, both of whom were in the W-P mode, achieved greater accuracy in encoding than in decoding, but used different strategies in attacking both tasks. Both boys started with very low accuracy scores for both decoding and encoding new words. In the initial periods, K made 6 per cent and M, 0 per cent correct responses to new words in each of the tasks. This was a function of their instructional mode. They initially had minimal information about sound-symbol correspondences and had to infer these from the whole word constellations which they had been taught. Where the two boys differed was in their decoding of "taught" words. K rarely forgot a word once he was told what it was and so was able to read many of the words which he confronted and use them to infer the separate sounds. M had great difficulty in retaining whole word information. For many sessions he made constant errors on the few words which he had been taught and despite enjoying the sessions, he appeared little concerned about the correctness of his responses. Not until the 11th session, following the introduction of a "reinforcement procedure," where he received a reward (a piece of red paper) for every correct response and the examiner received one each time M was wrong, did M begin to concentrate on the task and finally mastered the sight words he had been taught. For the next several sessions, although the "red paper game" was no longer used, he mastered some additional sight words but still had only a minimal base from which to make the necessary inferences and his performance on new words and their components was weak, indeed. For example, while K, in his initial period, gave 33, 58, and 33 per cent correct responses to C_1, V and C_2, respectively, in new words, M's percentages for the initial period were 21, 36, and 7. Generally, K's errors involved either reversals or substitutions for one component; M's were often totally unrelated to the stimulus or might include only one of the correct components.

For example, K responded with "mit" for "tim" or with "tip" for "pit"; he sometimes used a wrong initial consonant as in "tim" for "rim" or "zip" for "tip." He also made errors on the last consonant as in "pan" for "pad," "bat" for "bad," or "tim" for "tin," and frequently misread the medial vowel, substituting vowels which he had not yet or ever been taught such as "nut" for "nat," "sed" for "sad," "run" for "rat."

M's early errors were hard to classify. He read "pickle" for "sap," "sharla" for "pam," "school" for "pad," "tickle" for "pap," and "add" for "pan."

In encoding, the pattern was reversed. M produced assemblages of letters which had considerable resemblance to the stimulus word, for example "psm" for "pass," "st" for "sit," "tp" for "tip," "tk" for "tac" (though he had never met a k in any of his teaching words). K's assemblages were further removed from the stimulus words as, for example, "d" for "sass," "snt" for "miss," "pma" for "dim," and "pas" for "sim."

During the second phase, K began to use segmentation in decoding his "taught" words. He did this not because it facilitated his reading of the words to which he had been exposed before; he knew those well. It was, rather, as if he was using his knowledge of the whole word to test the accuracy of the sound-symbol correspondences which he had inferred. Once he discovered this procedure, he began and continued to apply segmentation to the encoding of many of his words. He used this strategy between 80 and 90 per cent of the time on C_1 and V_1 but only about 2/3 of the time on C_2. He encoded the first consonant with 96 per cent accuracy and made less than 20 per cent errors on the vowel and final consonant. His whole word accuracy went from 6 per cent in the first period to 68 per cent in the last period. But he almost never applied an overt segmentation strategy to new decoding words. When reading, he apparently continued to rely on whole word constellations. But, this procedure yielded only a 33 per cent final rate of accuracy for decoding whole words. The high error rate was largely a function of position errors. For example, he included a correct C_1 in his responses 71 per cent of the time, but read it in the first position in only 57 per cent of his decoding responses. Similarly, positioning errors lowered his accuracy for the vowel from 62 to 57 per cent and for the C_2 component, from 76 to 67 per cent.

Despite the paucity of information which he had acquired by the second phase, M's encoding accuracy for new whole words moved from 0 to 65 per cent. This may be attributed to his early identification of at least one correct component in each encoding effort and by his use of letter names as mediators between the sounds he heard in the stimulus words and the selection of a grapheme. He did overtly sound out or say the letter name (or both) of some of the components for a brief period, long enough to help him test out a strategy. But once established, he rarely resorted to overt segmentation, though he may have "thought" or silently articulated the component sounds. During the last period, M reached 74 per cent accuracy on encoding whole words and identified and positioned the consonants correctly about 90% of the time. The lower accuracy for the vowels (74 per cent) may have been related to the lack of correspondence between the short vowel sounds and the names which he sometimes used to find the correct graphemes. During the last period, the majority of M's encoding errors involved omission of the vowel or the substitution of an incorrect vowel.

By Period III, M and K both reached a higher rate of accuracy in encoding than in decoding. But M made the greater progress, reaching 52 per cent accuracy for whole words and almost 100 per cent accuracy for the consonants. However, he continued to have difficulty with the vowels and produced an incorrect vowel sound 45 per cent of the time. In fact, out of the 14 words read incorrectly after 4/15--the start of the last period--11 involved only the substitution of an incorrect vowel. Thus, both of the children in the W-P mode, who had never been given any phono-graphemic information, developed effective encoding strategies, at least for CVC words. K achieved it by testing a sounding out approach on known reading words and then transferring this procedure to encoding new words and continued to use it effectively. M had a very short romance with sounding the components out loud, but this brief time appeared to be sufficient. By the end of the second period he had an effective strategy which made use of occasional segmentation, use of letter names and, apparently, a procedure for identifying component sounds silently and going directly to the graphemes.

But decoding did not fare as well. It is difficult to say why neither of the boys used an overt segmentation strategy when confronted by new words to decode. They both used it in responding to previously taught words; and M used it occasionally and K consistently during the last period when encoding. But for new words, each boy made only two or three efforts to segment a component when decoding. However, the "silent" encoding strategy which M had developed apparently served him to some extent in decoding as well. In the last period, he reached almost 100% accuracy for the consonants and it was only his failure on the vowels which kept his whole word decoding accuracy (52 per cent) so much lower than his encoding accuracy (74 per cent). K, who didn't use his overt segmentation strategy in decoding, apparently had little else to fall back on. He did achieve between 57 and 67 per cent accuracy on each of the three components, but he put them together to produce a correct whole word response only about 1/3 of the time.

A's performance compared to M's and K's. In contrast to the two W-P children, A early evolved a procedure for using the phono-graphemic information with which she had been presented. By sounding out each component she achieved a 54 per cent accuracy rate for encoding new words in the first period. In fact, she rarely missed either the initial or final consonant and almost all her errors were related to the vowel. But during the course of the year, A's accuracy increased by only 10 per cent so that at the end, her encoding, which started out at a high level, was less accurate than either M's or even K's. This phenomenon may be explained by A's resistance to the encoding task so that she engaged in it less frequently and had less practice than the other two.

In decoding, A was the most successful of the three children initially (41 per cent accuracy as compared to K's 6 per cent and M's 0 per cent). But she only showed about a 25 per cent improvement so that her decoding became accurate about 2/3 of the time. Once again, most of her errors were due to vowel confusions.

KM's reading strategy. KM had evolved an effective, albeit somewhat limited, decoding strategy before entering the project. She had apparently acquired sufficient information about consonant sounds from learning large numbers of sight words in t/o and was able to read large amounts of material, even new material (and even in ita), when it appeared in context. KM's only difficulty was with vowels which she generally decoded accurately in context but which she misread in words presented in isolation, whether they were meaningful or nonsense words. She showed similar problems in encoding because she had no visually interpretable context to help her along. KM improved considerably in vowel accuracy during the course of the year, but her encoding was still too limited to enable her to write stories.

Implications

The analyses of the children's decoding and encoding strategies leave no doubt that, at least for some children, encoding presents an easier task, as discussed in the introduction to this section. In encoding, the stimulus and the initial response (some form of overt or silent spelling or sounding out) are both in the same modality and the visual modality becomes involved only after the sound or the name of the symbol has been determined. Both K and M did, indeed, go about the task in the expected fashion and found it a far easier task than decoding. To what extent this was a function of being taught by a whole word method is difficult to determine, since there was only one child who learned with any degree of success in the P-W method. But this is a most interesting question to investigate.

The use of ita makes it possible to plan the early phases of "reading" instruction through an encoding program, using a typewriter keyboard or manipulable pre-formed letters to eliminate the interference of the actual writing process which requires a level of fine muscle dexterity which young children often lack. It would be worthwhile to study the children's progress toward "writing" stories and to map the various strategies that children may evolve in going from their natural language to the written equivalent. For many children this may turn out to be an easier route to reading than beginning with decoding what someone else has written. It may be that such an approach will lead to better comprehension than results from early decoding. In encoding, the idea precedes the translation into symbols; the child knows the content of what he is going to encode. It doesn't get lost as he moves sequentially from word to word. When he has finished, even if there are some errors, he knows what has been written. In decoding, the content is locked into the printed page and because extracting it requires a slow and laborious process in the initial stages, the children attend more to "saying" words correctly than to the meaning they convey. There are certainly some children, like KM, for whom this is not true. But for most young children, extracting meaning is secondary to the processing of the grapho-phonemic stimuli.

The availability of ita makes such a study possible and the relative accessibility of ita typewriters makes it feasible.

From the findings of the project we believe that schools would do well to use ita in early instruction, even if only for a year, in order to make it possible for children to learn to encode so as to be able to tell their own stories on a "printed" page and, thus, grasp, through their own efforts, the nature of the relationship between their language and printed symbols.

Postscript

The year's work with the six children provided a rich source of data about children's step-by-step acquisition of reading skills. We learned a great deal about what elements tend to be confusing, which readily mastered, what effect the meaning of words has on decoding and encoding performance and, above all, how children evolve strategies for dealing with the decoding and encoding tasks. But what we learned, as presented in this report, is just a beginning in the process of mapping children's approaches to the reading task. The hypotheses raised by our findings and discussed in the implications sections throughout the report need to be tested with larger numbers of children from more varied backgrounds.

The ita medium provides a unique vehicle for studying the kinds of questions which we have raised. Many of them could not possibly be addressed through the use of traditional orthography. We hope that the ita Foundation will see the importance of fostering and supporting further studies of the processes by which young children learn to read and write.

A

Introduction

Screening Test Performance

A. indicated a strong knowledge of letter names and sound-symbol correspondences on the screening test. She produced the names of 17 graphemes (3 vowels, 14 consonants) and recognized an additional six by name (1 vowel, 5 consonants). She produced the phonemes for 12 graphemes (1 vowel, 11 consonants) and was able to recognize an additional five phonemes (1 vowel, 4 consonants), indicating a stronger knowledge of consonants than of vowels. Her auditory segmentation of initial consonants was correct in all of nine cases, though she was correct only once on final consonant segmentation. A.'s auditory blending skills were weak, although most of her attempts included at least one phoneme of the original stimulus (e.g. /f//a//t/ was blended as "toe"). She was unable to read any words from the Durkin list and indicated some confusion about her middle and last name. In addition, while she indicated some knowledge about the components of the reading task (e.g. that it involves words read from left to right) she believed that a single written word could be read in more than one way (e.g. "happy" could be "face" or "smile"). While few visual discrimination errors were observed in a letter matching task, she was less accurate on letter order matches (e.g. both "give" and "evig" were said to match with "give").

Behavior and Disposition

A. is a somewhat distractible and strong-willed child. This presented a small bit of difficulty in our attempts to keep her "on-task." However, she indicated an eagerness and willingness to learn how to read and was amenable to our direction in most tasks. One difficulty that did arise was her near-total resistance to encoding. This was unfortunate since it reduced our data base on this topic.

Treatment Implementation

Since A. indicated strong phonemic knowledge and adequate segmentation skills, she was placed in the part-whole (P-W) approach. In this approach the child is required to utilize the phonemic information supplied to decode and encode words which are never taught; phoneme-grapheme correspondences are the units of instruction. Since A. indicated neither a complete nor a minimal knowledge about the reading task and its component skills, and demonstrated a good grasp of phonemic information (and not sight word information), it was considered appropriate to instruct her in the P-W approach.

During our 35 sessions together from 11/15/76 to 4/28/77, A was presented with 17 i/t/a graphemes: thirteen consonants and four vowels (see Appendix A). These graphemes were utilized in a variety of decoding and encoding tasks and were presented in a number of different formats with different materials. These included game boards (e.g. bingo), stories, flash cards and encoding boards. Three sight words ("the," "is," "on") were also included in the curriculum.

The process information that was emphasized in her sessions was of three types: (1) from the start she was encouraged to apply the principles of auditory segmentation and blending to visually presented stimuli; (2) approximately midway through our sessions (on 2/14/77) she was requested to refrain from segmentation when possible (this is discussed further in the segmentation analysis); (3) in the last two sessions she was given instructions concerning the transition from i/t/a to traditional orthography (t.o), since her school utilized t.o. in its beginning reading instruction.

A was presented with a total of 229 decoding generalization words and 33 encoding generalization words over the course of her 35 sessions with us. The small number of encoding words was an unfortunate by-product of her firm resistance towards the encoding task. More than half of these generalization words were of a CVC configuration; in decoding, particularly, a number of non-CVC configurations were also included. The generalization words were presented only in isolation for the encoding task, while 22 of the 229 decoding words were presented in a setence context; the remainder were presented in a variety of individual word formats. Some of the following analyses on decoding tasks examine A.'s performance during four periods which correspond to the introduction of a new vowel into the curriculum; encoding performance has been broken down into only 2 phases - the a/i period (11/15 - 2/7) and the /e period (2/14 - 4/28), due to the small number of words which she agreed to encode. Unless otherwise noted, the analyses concern performance on generalization words, rather than on previously presented words.

Accuracy on Whole Words and Individual Components

Whole Word Accuracy in Decoding and Encoding

A.'s encoding and decoding skills seemed to be roughly equivalent with regard to whole word accuracy. She averaged a 63% accuracy in both decoding (see Table 1) and encoding (see Table 2) CVC generalization words. She was variable in her decoding of non-CVC configurations, ranging from only 22% decoding accuracy (see Table 3) on CCV configurations (e.g. "clω"), to 65% accuracy on VC configurations (e.g. "at"). Too few non-CVC configurations were presented in encoding to assess comparable accuracy rates in that task.

Individual Component Accuracy

CVC decoding words. On the initial consonant (C_1) A. made five substitution and six omission errors (see Table 1). Over all the sessions, A. responded correctly to the C_1 about 88% of the time, when an effort was made to read the word. In fact, her accuracy of decoding C_1 moved from 71% in the first period to 92% in the final period. An example of a substitution error was her response to "pωl" as "fωl;" an example of an omission error was her failure to give a whole word response to "tap" after she had sounded

Table 1-A
Whole Word and Component Accuracy of CVC Decoding Words in Four Time Periods[a]

			Components of CVC									Whole word		
			C_1			V			C_2					
Time period	Total N		Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	No response
11/15-12/9	17	n	12	0	4	11	1	4	8	4	4	7	5	5
		%	71	0	24	65	6	24	47	24	24	41	29	29
12/13-2/7	33	n	30	0	0	25	4	1	27	3	0	22	8	3
		%	91	0	0	76	12	3	82	9	0	67	24	9
2/14-3/31	39	n	35	3	1	32	6	1	32	5	2	26	12	1
		%	89	8	3	82	15	3	82	13	5	67	31	3
4/4-4/28	39	n	36	2	1	31	7	1	35	3	1	26	13	0
		%	92	5	3	79	18	3	89	8	3	67	33	0
11/15-4/28	128	n	113	5	6	99	18	7	102	15	7	81	38	9
		%	88	4	5	77	14	5	80	12	5	63	30	7

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[a] The four time periods correspond to the introduction of the four vowels into the curriculum.

Table 2-A
Whole Word and Component Accuracy of CVC Encoding Words in Two Time Periods[a]

			Components of CVC									Whole word		
			C_1			V			C_2					
Time period	Total N		Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	No response
11/15-2/7	13	n	11	0	1	7	1[b]	4	10[b]	1	1	7	5	1
		%	85	0	8	54	8	30	77	8	8	54	38	8
2/14-4/28	14	n	14	0	0	10	3	1	13	0	1	10	4	0
		%	100	0	0	72	21	7	93	0	7	64	36	0
11/15-4/28	27	n	25	0	1	17	4	5	23	1	2	17	9	1
		%	93	0	4	63	15	19	85	4	7	63	33	4

[a] The two time periods correspond to the introduction of the first (a) and third ( ) vowels into the curriculum.

[b] The one occurrence of positioning error on the V and C_2 is included here (1/24, fin = fna).

out each of the component phonemes.

Table 3 - A

Presentation Frequency and Response Accuracy: Non-CVC Decoding Generalization Words

Configuration	No. presentations	% Accuracy
CV	15	60
VC	17	65
VCC	10	30
CCV	9	22
CVCC	24	63
CCVC	26	54
Total non-CVC	101	

Decoding of the final consonant (C_2), was slightly more error prone, particularly in the earlier sessions. In the first period her accuracy was only 47% on this component; however, in the second and later periods she achieved an accuracy rate of over 80%.

Vowel decoding indicated an accuracy pattern somewhat similar to that for the C_2; beginning with a rate of 65% accuracy in the first period, her accuracy increased to 76%, 82% and 79% in the remaining three periods. However, the type of errors for these two components differed. While the C_2 became decreasingly prone to either substitution or omission errors, the vowel became less prone to a no response/omission type of error over time (24% in the first period, only 3% in the last period), but somewhat more prone to substitution errors (from 6% to 18%). Although the C_2 started out at a lower rate of accuracy than the vowel, the former ultimately attained a higher level of accuracy in the final period than the latter.

Non-CVC decoding words. The question must arise, then, whether the increase in substitution error on the medial vowel is a question of less attention to the medial position, or one of particular difficulty with vowels compared to consonants. To answer this question in part, a comparison was made of accuracy by position in all three-component configurations, the CVC, the VCC and the CCV, disregarding the positional change errors. As displayed in Table 4, accuracy of identification of the correct sound of the individual components was about equal in the CVC's and the VCC's (although whole word accuracy was considerably lower in VCC's due to positioning errors). In the CCV's however, while sounds of the two consonants were again quite accurately decoded, (with the C_1 slightly more accurate than the C_2), the vowel (which was now in the third position) was more often incorrect than correct. It is clear that a vowel in the third position offered the greatest difficulty of all.

Table 4 - A
Accuracy of Decoding the Two Consonants and the Vowel in Three-Component Words

Configuration	Total N	Correct (in%)			
		Whole Word	Components		
			Position 1	Postion 2	Position 3
CVC	128	63	88	77	80
CCV	9	22	100	89	33
VCC	9	30	89	78	78

Note. This analysis does not include positional change errors as incorrect.

CVC encoding words. As indicated in Table 2, C_1 was responded to with 93% accuracy on the average. The only error was one of omission, which occurred when the word "dad" was correctly segmented, but A made no encoding attempt (on 11/29). The C_2 also showed high overall accuracy (85%). Two omissions of the C_2 occurred, for example, when the initial "b" of "bet" was segmented and selected, but the remainder of the word was ignored. One substitution error occurred (e.g., "did" was encoded as "dt"). The vowel had the lowest accuracy rate (63%), with four substitution (e.g., "men" was encoded as "man" on 4/4) and five omission errors (e.g. on 1/17 "mil" was encoded as "ml"). As more vowels became available to her, A's tendency to make a substitution error increased, although her rate of vowel omission decreased.

Positioning Errors in Decoding and Encoding

CVC configurations. At no time during her sessions did A. include a correct component of the stimulus word in an incorrect position in her response to any CVC decoding generalization word. An example of such an error would be the response of "tap" to the stimulus word "sat"; a similar error would be that of a complete reversal, for example, responding to "sat with tas." In addition, only one such error occurred on a CVC generalization encoding word: on 1/24 she encoded "fin" as "fna." Thus, for A. positioning errors were virtually nonexistent in both the decoding and encoding of CVC words.

Non-CVC configurations. In contrast to her performance on CVC's, other configurations presented to A. for decoding revealed a slight tendency to change the position of a stimulus component, even when it was given the appropriate sound. Only the CV pattern remained free from any "partial" or complete reversals.

Generalization words of the VC, VCC, CVCC or CCVC configurations were infrequently subject to positional change errors. On only six out of 77 words which fill any of these four patterns, she identified one or more of the sounds correctly but made positional errors. For example, she read the VC "af" as "fan", and the VCC's "asp" as "sap" and "aps" as "pas." For CCVC "slid" she had all the correct sounds, but read it as "sild", whereas, some months later, she read "sind" as "slid", substituting an "l" for the "n", and reversing the position of the vowel.

In the CCV pattern, she mispositioned at least one correctly identified element in 6 of the nine words with which she had been presented. Five of these errors, were a transformation of the CCV into a CVC; the sixth was to a CVCC, extending the basic CVC form. For example, she read "fl[illegible]" as "fol", "sl " as "s[illegible]l" and then "sol" and "bl[illegible]" as "bill." (For a complete list of these decoding errors see Chart 1). It would appear that a strong "CVC set" may have been established by the predominate use of this configuration in the reading sessions, which encouraged positioning errors on other configurations. Unfortunately, it was not possible to perform a similar analysis on encoding generalization words, as too few of them were of a non-CVC configuration.

Overt Segmentation

Frequency in Decoding and Encoding CVC Generalization Words

In general, A. sounded out components of the CVC's more often in decoding than in encoding. As noted in Table 5, when decoding, the individual components of the CVC generalization words were each segmented correctly about 70% of the time. In encoding, however, the C_1 was segmented only 44% of the time, the V 30% and the C_2 only 15% of the time (see Table 6). The few segmentation errors which appeared in decoding (usually on the C_2) were never made in encoding.

The tendency to sound-out while decoding moderately decreased from the early sessions to the later ones. The reverse was true for encoding, where an increase in segmentation frequency was observed. It is not possible to attribute this decrease in overt segmentation of decoding words solely to greater facility of decoding. Since A. used the sounding-out strategy consistently, even on words with which she had been previously presented, by mid-year (2/14) she was explicitly directed to not "sound-out" if she didn't have to; it was from that time on that she began to rely less on segmentation in her decoding. However, this change in strategy was not apparent in her encoding; she tended to sound out more after 2/14 than she had previously.

Relationship to Accuracy on CVC Decoding and Encoding Words

While in the beginning sessions segmentation of individual components occurred quite frequently in decoding and considerably less often in encoding, her general accuracy was at the same level (63%). It is there-

Chart 1 - A

Positioning Errors in Varied Configurations Presented For Decoding

Configuration	Number of Errors	Date	Stimulus	Response	Type of Change
CVC	0	--	--	--	--
CV	0	--	--	--	--
VC	2	11/15	ap	/pa//it/, -	(?)
		1/27	af	fan	into CVC
VCC	2	11/19	asp	/a//s//p/ sap	into CVC
		11/29	aps	/a//p//s/ aps, pas	into CVC
CCV	6	2/14	flω	/f//l//ω/ fəl	into CVC
		2/28	slω	/s//l//ω/ sωl, sol	into CVC
		3/3	crω	/c//r//ω/ cuɹl	into CVCC
		3/3	cri	/c//r//a/ cuɹ	into CVC
		3/3	blω	/b//d//b//l//ω/ bill	into VC
		4/18	clω	/c//l//ω/ claw, cωl	into CVC
CVCC	1	4/18	sind	slid	into CVC
CCVC	1	1/27	slid	sild	into CVC

Table 5-A
Frequency of Overt Segmentation and Relationship to Accuracy on Components of CVC Decoding Words in Two Time Periods[a]

Time period		Total presentations	No response	Incorrect segment.	C_1				V				C_2			
					Segmented		Not segmented		Segmented		Not segmented		Segmented		Not segmented	
					Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct
11/15-2/7	n	50	4	3[b]	38	34	8	8	38	28	8	8	35[b]	28	8	7
	%		8		76	89	16	100	76	74	16	100	70	80	16	88
2/14-4/28	n	78	0	8[b]	51[b]	49	26	22	51[b]	48	24	15	50[b]	47	24	18
	%		0		65	96	34	85	65	94	31	63	64	94	31	75
11/15-4/28	n	128	4	11[b]	89[b]	83	34	30	89[b]	76	32	23	85[b]	75	32	25
	%		3		70	93	27	88	70	85	25	72	66	88	25	78

[a] The two time periods correspond to the introduction of the first (a) and third ( ) vowels into the curriculum.

[b] C_1 was incorrectly segmented once in the 11/15-2/7 period; V was incorrectly segmented three times in the 2/14-4/28 period; C_2 was incorrectly segmented three times in the 11/15-2/7 period, and four times in the 2/14-4/28 period.

Table 6-A

Frequency of Overt Segmentation and Relationship to Accuracy on Components of CVC Encoding Words in Two Time Periods[a]

Time period		Total presentations	No response	Incorrect segment.	C_1				V				C_2			
					Segmented		Not segmented		Segmented		Not segmented		Segmented		Not segmented	
					Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct
11/15-2/7	n	13	1	0	4	3	8	8	2	1	10	6	1	0	11	10[b]
	%		8		31	75	62	100	15	50	80	60	8	0	85	91
2/14-4/28	n	14	0	0	8	8	6	6	6	5	8	5	3	3	11	10
	%		0		57	100	43	100	43	83	57	63	21	100	79	91
11/15-4/28	n	27	1	0	12	11	14	14	8	6	18	11	4	3	22	20
	%		4		44	92	52	100	30	75	67	61	15	75	81	91

[a] The two time periods correspond to the introduction of the first (a) and third ( ) vowels into the curriculum.

[b] The single occurrence of incorrect V and C_2 placement is contained here (1/24 fin = fna).

fore interesting to observe the extent to which overt segmentation seemed to be related to accuracy of identification of each of the components in the two tasks in the earlier compared to the later sessions.

Tables 5 and 6 indicate a clear pattern which emerged in both decoding and encoding. In earlier sessions all three components were more accurate when not segmented than when they were segmented; this held for both decoding and encoding. For example, in decoding, the V was 100% accurate when not segmented and 74% accurate when segmented during these earlier sessions. However, the inverse was true in the later sessions: for all three components in decoding, and for the V and C_2 in encoding, accuracy was higher when segmentation occurred that when it did not. For example, the V was 94% accurate when segmented and only 63% accurate when not segmented.

Another way of looking at this data is to notice that, in decoding, when a component was segmented in earlier sessions a lower accuracy rate was achieved than when segmentation of that component occurred in later sessions. For example, the C_2 was decoded accurately 80% of the time when segmented in earlier sessions, and decoded accurately 94% of the time in later sessions when it was segmented.

When overt segmentation was not observed, accuracy dropped in the later sessions. For example, the C_2 was decoded accurately 88% of the time in early sessions and 75% of the time in later sessions. This pattern of poorer accuracy on non-segmented components in the later sessions was not evident in encoding as it was in decoding; the decoding pattern of increased accuracy on segmented components in later sessions was also found in encoding.

A legitimate question to now ask is: what does this rather strong pattern suggest? Since decoding accuracy on each component dropped from the initial to the final stages when not segmented, we must bear in mind the instructions A. received on 2/14 (the first day of the second period) to "not sound out" whenever possible. This explicit direction seemed to have increased her rate of non-segmentation, but was apparently suggested before she was ready to utilize that approach adequately; it appears that A. found segmentation to be a useful crutch, evidenced by her poorer accuracy on non-segmented components in the later sessions. Given that, it seems reasonable to suggest that A. dispensed with segmentation in the earlier sessions only when she was confident of the material, and used it to facilitate decoding and encoding words of which she was less sure. In the later sessions A. apparently used segmentation on fewer components of a word but was not yet efficiently recognizing those stimuli on which it was less necessary, such that she neglected to sound-out some stimuli which she should have checked on before uttering her whole word response. Reasonable conclusions seem to be: (1) that segmentation was facilitative, and (2) that it was employed on those components of which she was less sure.

Less Frequently Presented Graphemes and Previously Presented Words

Further support for the hypothesis that segmentation was facilitative and was employed on elements of which A. was less sure would be indicated if, (1) components (e.g. consonants or vowels) of lower overall accuracy tended to be segmented more frequently; (2) newly introduced elements were segmented more frequently during initial presentations than in later presentations (after a period of consistently accurate usage); or (3) if "old" words (i.e., those with which A. had been presented at least once before) were segmented less frequently, with higher accuracy rates, than were new ("generalization") words.

Table 7 indicates the comparative accuracy of 15 vowels and consonants (those used in the curriculum a sufficient number of times for a comparison to be made in decoding), and the rate of segmentation A. used with each. A rough comparison has been made by aligning the graphemes according to their respective accuracy rates (from highest to lowest for the 15 graphemes)

Table 7-A
Comparison of Accuracy Rate of Curricular Graphemes with Rate of Segmentation in CVC Decoding Generalization Words

Grapheme	% Segmentation	% Correct	Segmentation ranking[a]	Average segmentation ranking
c	44	100	15	
r	67	100	11	
l	77	95	5	10.6
n	71	94	10	
Sh	63	90	12	
	56	86	14	
f	80	85	3.5	
d	60	83	13	7.6
t	76	83	6	
b	82	82	1.5	
p	75	79	8	
i	80	78	3.5	
s	82	75	1.5	5.6
a	74	73	9	
m	76	71	6	

[a] Ranks go from: 1 = most often segmented, to 15 = least often segmented.

and comparing them by three groups of five letters each: highest (c,r,l,n,sh), medium (ω,f,d,t,b) and lowest (p,i,s,a,m) in accuracy. When the average ranking of segmentation rate was made for each of these letter groups it was found that the most accurate groups tended to be the least-often segmented (average ranking was 10.6 out of 15), the lowest accuracy group was the most often segmented (average ranking 5.6) and the medium-accuracy letter group fell in the middle (7.6 average ranking). While this is only a rough comparison, it does seem to indicate that A. used a sounding-out process on those elements of which she was less sure, so that greater segmentation was used with those graphemes which had lower accuracy. It should be noted that these results could suggest an alternative hypothesis: that segmentation actually impeded accuracy. However, this is clearly not the case. As Table 5 indicates, in decoding, segmentation resulted in a slightly higher accuracy rate for both consonants and vowels.

A difficulty with the above analysis is that the five graphemes of lowest accuracy (p,i,s,a,m) were among those which were presented to A. in the earliest sessions. It is possible that the greater segmentation found on these consonants was simply a result of A.'s greater tendency to segment in the earlier sessions than in the later sessions. It is also possible to speculate that the lower accuracy rate of decoding these consonants was a function of the more numerous presentations over 35 sessions. However, when the second approach is applied, i.e., an examination of the components during the first half of their periods of usage compared with the later half, a clearer picture emerges. Table 8 indicates that on ten of 14 graphemes (i.e., those which had been presented a sufficient number of times in decoding tasks) greater segmentation occurred during the first half of the usage periods than for the second half. For example, the "p" was segmented 90% of the time in its earlier presentations and only 45% of the time in its later presentations.

The final analysis made concerning the possible facilitative use of a segmentation strategy, was to examine A's sounding-out patterns on "old" words (i.e., those to which she had been exposed on at least one prior occasion). A had segmented her "new" (generalization) words 74% of the time (see Table 9) in some way. She segmented "old" words only 50% of the time. When segmented, "new" words were as accurate (70%) as were old words (71%). However, those "old" words which she did not segment were accurate 79% of the time, while "new" words not segmented were responded to accurately only 48% of the time.

Table 8 - A
Comparison of Amount of Segmentation of Individual Graphemes in Decoding in First Half and Second Half of Sessions Presented

Time period	s	a	p	t	m	d	n	i	r	l	f	c	b	(o)
	Segmentation (%)													
First half	88	81	90	90	100	75	78	85	50	83	71	25	85	57
Second half	70	55	45	68	50	53	63	78	80	70	100	63	75	100

Table 9 - A
Accuracy and Segmentation Frequency of CVC Generalization Words and CVC Words Which had been Presented Previously

Type of word	Frequency of segmentation	Accuracy		
		Segmented words	Non-segmented words	All words
Generalization words	74%	70%	48%	63%
Previously presented words	50%	71%	79%	75%

In summary, these results seem to suggest that, when decoding words she had seen before, she relied on segmentation less often, since she apparently felt more sure of her ability to read them. We can also surmise that the lack of any greater facilitation due to segmentation on old words may have stimulated the development of A's tendency to reduce her overt segmentation on these words, since this strategy is a more rapid and efficient approach.

Segmentation styles

CVC decoding and encoding words. A comment must be made concerning A's segmentation "styles", i.e., the way in which she sounded-out (or did not sound-out) the phonemic equivalents of the graphemic stimuli. In the early sessions, A. would consistently break out each of the three phonemic "bits" of the CVC when decoding. An example of such segmentation is the sounding of the phonemes /b//a//t/ to the stimulus "bat", before uttering the whole word response. Table 10 indicates that this mode of sounding out was clearly A's preferred style; of the 128 CVC decoding generalization words with which she was presented, 59% were completely sounded-out. The only other approach that was regularly observed in decoding was the lack of any segmentation whatsoever; 23% of her whole word responses were made without any prior segmentation. That it occurred so much less often is understandable: with no overt segmentation, her accuracy in the whole word response was only 48%, while with complete sounding-out, her accuracy was 80%. It is less clear why she did not move to alter the three-bit segmentation to a more efficient mode, (perhaps segmenting only those elements of a stimulus word of which she was less sure). On the few occasions alternate segmentation styles were observed (e.g. segmenting only the vowel, -/V/-, as in the response /ω/ "r ω d", to that stimulus), her accuracy on the whole word response was considerably high.

A contrast of segmentation style in encoding to that found in decoding is informative. As was noted earlier, a non-segmented mode appeared to be more often preferable in encoding than in decoding. When segmentation did occur, it was not regularly of the C/V/C mode (see Table 11); this occurred on only two of the 27 encoding generalization words. However, this is not to suggest that little segmentation occurred; indeed, on 14 of the encoding words A did attempt some sort of segmentation; 12 were encoded with no segmentation at all. In contrast to decoding, where only a 48% accuracy resulted on non-segmented responses, 67% of the non-segmented

Table 10-A
Segmentation and Non-Segmentation Styles of CVC Words: Frequency of Occurrence and Relationship to Accuracy of Whole Word Response

Segmentation style	Frequency		Whole word response					
			Correct		Incorrect		None	
	n	%	n	%	n	%	n	%
C/V/C	76	59	61	80	15	20	-	-
Incorrect segmentation	8	6	2	25	6	75	-	-
Correct segmentation, no whole word response	4	3	-	-	-	-	4	100
Incorrect segmentation, no whole word response	2	2	-	-	-	-	2	100
-/V/-	2	2	1	50	1	50	-	-
-/V/C	1	1	1	100	-	-	-	-
-/-/C	1	1	1	100	-	-	-	-
C/-/-	1	1	1	100	-	-	-	-
Total all segmented	95	74	67	70	22	23	6	6
No segmentation	29	23	14	48	15	42	-	-
No response	4	3	-	-	-	-	4	100
Total	128		81	63	37	29	10	8

Table 11-A
Segmentation and Non-Segmentation Styles of CVC Words: Frequency of Occurrence and Relationship to Accuracy of Encoding Response

Segmentation style	Frequency		Whole word response					
			Correct		Incorrect		None	
	n	%	n	%	n	%	n	%
C/V/-	5	19	4	80	1	20	-	-
C/-/-	3	11	1	33	2	67	-	-
C/V/C	2	7	2	100	0	0	-	-
CV/C	1	4	0	0	1	100	-	-
C/VC	1	4	1	100	0	0	-	-
Correct segmentation, no encoding response	1	4	-	-	-	-	1	100
Total all segmented	14	52	9	64	4	29	1	7
No segmentation	12	44	8	67	4	33	-	-
No response	1	4	-	-	-	-	1	100
Total	27		17	63	8	30	2	7

encoding responses were completely correct. When some sort of segmentation occurred, the encoded word was accurate 9 of the 14 times (64%), nearly equal to the accuracy of non-segmented responses. It is clear that little facilitation resulted from segmentation in encoding; it is not surprising, therefore, that it was applied less frequently in encoding than in decoding, as it was apparently less necessary.

Non-CVC configurations. A overtly segmented CV bigrams 80% of the time and was most accurate when she did so (see Table 12). Whenever segmentation did occur, both phonemes were sounded out (e.g., for "sω" she sounded out both /s/ and /ω/), although occasionally the final whole word response was incorrect. The VC bigrams showed a similar two-bit sounding-out pattern. On only one occasion when segmentation occurred, was only a single phoneme sounded; i.e., the /a/ of "as". Once again, her total word accuracy was greater when segmentation occurred.

All nine of the CCV generalization words presented to A, were segmented; every segmentation was of three "bits" (designated as C/C/V; an example of this is sounding the /f//l//ω/ of "flω"). This was the configuration with which A had the greatest difficulty (only two of the nine words were accurately decoded), largely due to problems with the vowel. The VCC, which was also low in total word accuracy (only 30%), was also frequently segmented; nine of the ten generalization words of this configuration were segmented. Once again, the segmentation was three-bit (V/C/C). The only occurrence of non-segmentation was on a word that was an extension of another she knew quite well and had seen a number of times previously; this was the syllable "ats" which she read incorrectly as "at."

The CCVCs (e.g., "crab") and the CVCCs (e.g., "milk") were segmented only slightly less often than were the CVCs. Twenty of the 26 CCVCs were segmented, usually into four "bits"; of these, twelve were correct in the whole word response. Of the six words which were not segmented, only one was correct in the final response. Regardless of segmentation, the second consonant (C_2) was the most prone to error, even though it was sounded out nearly as frequently as were the other three components. The majority of C_2 errors were ones of omission rather than substitution (e.g. reading "skωl" as "sωl"). A comparison of the C_2 in the CCVs and in the CCVC's (of which the CCVCs can be considered extensions) revealed that the omission of the C_2 in the final response to a CCV was less likely to occur, although the movement of the C_2 into a later position in the word was more likely to occur (e.g. "clω" was read as " cωl" rather than "cω", while "skωl" was more likely to be read as "sωl", than "sωkl").

Table 12 - A
Relationship Between Segmentation and Accuracy on
Non-CVC Decoding Words

Configuration	Frequency of segmentation		Accuracy when segmented		Accuracy when not segmented	
	n	%	n	%	n	%
CV	12	80	8	67	1	33
VC	12	71	9	75	2	40
CCV	9	100	2	22	-	-
VCC	9	90	3	33	0	0
CCVC	20	77	12	60	1	17
CVCC	17	71	13	76	2	29

The CVCC's were segmented in some way 71% of the time; decoding was more accurate when segmentation occurred (76%) than when it did not (29%). The style used in segmentation of words of this configuration was somewhat more variable than it was in the other non-CVC configurations, which were usually completely sounded-out. Instead of always using a four-bit segmentation pattern, A. occasionally sounded only the first two phonemes of the CVCC before uttering her whole word response. Examples of this are the response of /f//a/ to "fast", and /l//a/ to "laft." However, of the 17 CVCC words which were segmented in some way, 14 were sounded-out into "four bits."

In summary, it is quite clear that segmentation enhanced A.'s decoding performance on each of the individual components of non-CVC configurations as it had on CVC components. In addition, most of these less familiar configurations were segmented wholly (or partially) more often than were the CVCs. Only the VC bigrams and the CVCC's were segmented less often, the former of which was apparently the easiest to decode (having a 65% overall accuracy rate), and the latter of which can be considered to be an extension of the CVC configurations (having an accuracy rate of 63%). Finally, it must be recognized that A.'s sounding-out strategy was both extremely firm and highly systematic; she attended to each component of the stimulus word with little variation in the left-to-right three-bit pattern, unless segmentation was abandoned entirely.

Accuracy on Individual Consonants

Decoding

Only a few brief words need to be addressed to the specific substitution errors made on consonants in either decoding or encoding. As Table 13 indicates, accuracy of consonant decoding ranged from a low of 72% (on the "s") to a high of 100% (on the "r", "c" and "k"). Seventeen substitution errors were made; eleven of these could be specifically classified. Six of these were articulatory errors (i.e., "t" was decoded as /d/ twice; "d" was decoded as /t/ three times; and "m" was decoded as /td/ once). The remaining five classifiable errors were "combination errors", a substitution of a consonant both visually and articulatorily similar; three of these were the decoding of "b" as /p/ and one was the decoding of "p" as /b/; the last was the decoding of "s" as /z/. A.'s tendency to omit a consonant from the decoding response was at least as strong as was the tendency to substitute an erroneous phoneme. A total of 22 omission errors were observed in decoding. In toto, A. made some kind of error in decoding a consonant only 16% of the time; most of these errors occurred on consonants which were introduced in the first few sessions, and occurred during the initial presentations (see Table 13). Over time (see Table 14), most consonants either increased in accuracy (six) or remained at the same high accuracy level (five). Only the "b" and "p" consonants decreased in accuracy.

Table 13-A
Correct and Incorrect Decoding of Consonants in CVC Generalization Words: General Accuracy and Changes over Time

		All sessions					Over time			
		Total	Correct		Incorrect		11/15-1/10		1/13-4/28	
Consonant	Date of introduction	N	n	%	n omitted	n substituted	n presented	% correct	n presented	% correct
s	11/15	18	13	72	3	2	8	50	10	90
p	11/15	34	26	76	4	4	14	86	20	70
t	11/18	37	30	81	4	3	8	75	29	83
m	11/19	19	14	74	4	1	8	50	11	91
d	11/29	24	20	83	1	3	5	60	19	89
n	12/8	19	17	89	2	0	3	100	16	88
r	1/13	9	9	100	0	0	-	-	9	100
l	1/17	22	20	91	1	1	-	-	22	91
f	1/24	12	10	83	2	0	-	-	12	83
c	1/31	11	11	100	0	0	-	-	11	100
b	2/3	17	14	82	0	3	-	-	17	82
Sh	3/3	10	9	90	1	0	-	-	10	90
k	3/10	10	10	100	0	0	-	-	10	100

Table 14-A
Comparison of Changes in Decoding Accuracy of Individual Consonants During First Half and Second Half of those Sessions When Presented

Consonant	Date of introduction	First half n presented	First half % correct	Second half n presented	Second half % correct	Type of change
s	11/15	9	44	9	100	increase
p	11/15	21	86	13	62	decrease
t	11/18	15	67	22	91	increase
m	11/19	11	55	8	100	increase
d	11/29	11	73	13	92	increase
n	12/8	10	90	9	89	none
r	1/13	5	100	4	100	none
l	1/17	13	92	9	89	none
f	1/24	9	78	3	100	increase
c	1/31	7	100	4	100	none
b	2/3	13	85	4	75	decrease
Sh	3/3	8	88	2	100	increase
k	3/10	8	100	2	100	none

Encoding

Accuracy in encoding (see Table 15) ranged from 67% (on the "d") to 100% on eight of the twelve consonants which were presented for encoding. (Since the number of occurrences of each of these consonants in encoding was small, the percentages are not very reliable indices of accuracy). Errors of omission were more frequent than were errors of substitution. Only one substitution error occurred (a "t" was encoded for the final "d" of "did"), while five omission errors were observed. It is clear that the consonants in both decoding and encoding CVC generalization words gave only minimal trouble to A..

Accuracy on Individual Vowels

A. was taught a total of four vowels as isolated grapheme/phoneme correspondences. These vowels were "a", "i", "[illegible]" and "e", presented initially on 11/15, 12/13, 2/14 and 4/4, respectively. In the following analyses the session-by-session tabulation of decoding words have been collapsed into four periods which reflect the introduction of each of the four vowels. As a result, the first period was one in which A. dealt only with a single vowel, the "a"; the second period she dealt with two vowels, the "a" and the "i", and so forth. For encoding generalization words, the tabulations have been collapsed into only two periods (due to the small number of encoding words). These reflect the introduction of the "a" (the first vowel), and of the "[illegible]" (the third vowel). The following analyses deal with 126 of the CVC decoding generalization words presented throughout the 35 sessions and with the 27 CVC encoding words which A attempted. (Two additional decoding words used the "o", which was never taught.)

Decoding

A. was accurate on the vowel in 96 of the 126 generalization words (76%). None of the errors involved a misplacement of the vowel in the response. A total of 18 substitution errors were made (14%), nine errors were a result of no response and three involved the use of the schwa or

Table 15-A
Correct and Incorrect Encoding of Consonants in CVC Generalization Words: General Accuracy and Changes over Time

		All sessions					Over Time			
		Total	Correct		Incorrect		11/15-1/10		1/13-4/28	
Consonant	Date of introduction	N	n	%	n omitted	n substituted	n presented	% correct	n presented	% correct
s	11/15	6	5	83	1	0	1	100	5	80
p	11/15	0	-	-	-	-	0	-	0	-
t	11/18	7	6	86	1	0	2	100	5	80
m	11/19	7	7	100	0	0	3	100	4	100
d	11/29	9	6	67	2	1	5	40	4	100
n	12/8	5	5	100	0	0	1	100	4	100
r	1/13	1	1	100	0	0	-	-	1	100
l	1/17	5	4	80	1	0	-	-	5	80
f	1/24	5	5	100	0	0	-	-	5	100
c	1/31	1	1	100	-	-	-	-	1	100
b	2/3	4	4	100	0	0	-	-	4	100
Sh	3/3	3	3	100	0	0	-	-	3	100
k	3/10	1	1	100	0	0	-	-	1	0

actual omission of the vowel from the whole word response (see Table16).

During the period when only the "a" was presented (11/15-12/9) only one substitution error occurred (i.e., she read "map" as "mop"), but five no response errors occurred. When the second vowel (the "i") was included (12/13-2/7) her accuracy on the "a" was similar to that of the "i" (73% and 72% respectively). A. achieved an accuracy rate of 100% on both the "a" and the "i" by the final sessions; in only two cases were they substituted for each other (e.g. "cash" was decoded as "cish" on 3/3). The "ω" began at a high accuracy rate (90%); in the fourth period (4/4-4/28), she read the vowel in the two "ω" words correctly. One of the two substitution errors observed on the "ω" involved miscalling it /a/, the other error involved miscalling it /i/.

The "e", to which A. was exposed for only the last eight sessions was the most error-prone of the four vowels. In contrast to the "ω", on which she made only two errors in 20 presentations during the period in which it was first introduced, A made eight errors in the 21 decoding attempts with the "e", achieving only 62% accuracy. The eight errors all involved miscalling the "e" as either /a/ or /i/.

In summary, A. made 18 vowel substitutions in decoding 126 new words; twelve of these involved the substitution of an earlier-taught vowel for one more recently introduced (e.g., the substitution of /a/ for the "e"). The other six substitution errors involved the use of a vowel sound which had not been taught (e.g. /ow/ for "a" or /e/ for "i", before /e/ was introduced). A's decoding of "a", "i" and "ω" reached almost 100% accuracy during the final period. Furthermore, the "ω" was read far more accurately in the period in which it was first introduced than were either the "a" or the "i" in their introductory periods. The hypothesis that by the time the "ω" was introduced A had developed a more effective strategy for dealing with new vowels than she had used initially, was contradicted by her poor handling of the "e". However, her difficulties

Table 16-A
Accuracy of Vowel Decoding in CVC Words in Four Time Periods[a]

		Stimuli																											
		a							i														e						
		Responses																											
Time period		a	i		e	other	schwa omit	n.r.	i	a		e	other	schwa omit	n.r.		a	i	e	other	schwa omit	n.r.	e	a	i		other	schwa omit	n.r.
11/15-12/9	n	11	0	0	0	1	0	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	65	0	0	0	6	0	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/13-2/7	n	11	0	0	0	2	0	2	13	0	0	1	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	73	0	0	0	13	0	13	72	0	0	6	6	11	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/14-3/31	n	4	1	0	1	0	0	0	10	1	0	0	0	1	1	18	1	0	0	1	0	0	-	-	-	-	-	-	-
	%	67	17	0	17	0	0	0	77	8	0	0	0	8	8	90	5	0	0	5	0	0	-	-	-	-	-	-	-
4/4-4/28	n	7	0	0	0	0	0	0	7	0	0	0	0	0	0	2	0	0	0	0	0	0	13	5	3	0	0	0	0
	%	100	0	0	0	0	0	0	100	0	0	0	0	0	0	100	0	0	0	0	0	0	62	24	14	0	0	0	0
11/15-4/28	n	33	1	0	1	3	0	7	30	1	0	1	1	3	2	20	1	0	0	1	0	0	13	5	3	0	0	0	0
	%	73	2	0	2	7	0	16	79	3	0	3	3	8	5	91	5	0	0	5	0	0	62	24	14	0	0	0	0

---

[a] The four time periods correspond to the introduction of the four vowels.

Table 17-A
Accuracy of Vowel Encoding in Two Time Periods[a]

		Stimuli																											
		a							i														e						
		Responses																											
Time period		a	i		e	other	schwa omit	n.r.	i	a		e	other	schwa omit	n.r.		a	i	e	other	schwa omit	n.r.	e	a	i		other	schwa omit	n.r.
11/15-2/7	n	6	0	0	0	0	0	1	1	1	0	0	0	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	86	0	0	0	0	0	14	17	17	0	0	0	50	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/14-4/28	n	3	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	5	3	0	0	0	1	0
	%	100	0	0	0	0	0	0	100	0	0	0	0	0	0	100	0	0	0	0	0	0	56	33	0	0	0	11	0
11/15-4/28	n	9	0	0	0	0	0	1	2	1	0	0	0	3	1	1	0	0	0	0	0	0	5	3	0	0	0	1	0
	%	90	0	0	0	0	0	10	29	14	0	0	0	43	14	100	0	0	0	0	0	0	56	33	0	0	0	11	0

---

[a] The two time periods correspond to the introduction of the first (a) and third ( ) vowels into the curriculum.

with the "e" may be partially explained by the fact that the examiner's Western New York pronunciation of the "e" was similar to that of the /a/; this probably contributed to A.'s difficulties with that vowel.

Encoding

A. was slightly less accurate on the vowels in encoding (63%) than she was in decoding (76%). However, only four of her responses (15%) involved the substitution of an incorrect vowel (see Table 17); three of these occurred in response to a stimulus word which contained an "e" (e.g. on 4/4 "red" was encoded as "rad"). Six errors of omission occurred (22% of the total responses), the majority of which occurred during the earlier sessions (e.g. on 12/13 A. encoded "tim" as "tm"). The "a" and the "ŏ" were seldom, if ever, omitted, and were never replaced by other vowels in encoding. The "i", while never confused with another vowel, was most prone to omission errors; of the six omission errors, four involved the "i". The "e" was the only vowel for which substitution errors were regularly observed. These substitution errors occurred both with and without segmentation as did the omission errors. As has been noted previously, however, segmentation of the vowel improved encoding accuracy on that component.

The Role of Meaning

Accuracy on Meaningful and Nonsense Generalization Words

Of the 123 generalization words which were presented in an isolated manner (rather than in an embedded context), 97 could be unambiguously classified as either a meaningful word or a nonsense syllable. Eighty-one of these were meaningful, (e.g. "sat") while 16 were classified as nonsense stimuli (e.g. "dap"); the remaining words were either meaningful (but not judged to be so to a young child), or had been presented in an embedded context and were excluded from the present analysis. As Table 18 indicates, A. responded to meaningful words more accurately (65%) than she did to nonsense syllables (44%). Although she had a similar error rate on the two types of words (28% for meaningful, 31% for nonsense), it was the higher rate of no whole word response to nonsense syllables which decreased her decoding accuracy on these stimuli. An examination of the four nonsense syllables to which A. gave no response revealed that three of them were configurations which contained the same consonant in both the initial and the final positions (e.g., "faf"). A total of six such configurations had been presented to A. (three of which were responded to, albeit incorrectly); she consistently stated that she disliked words containing two identical consonants. For this reason, the greater frequency of nonresponse to nonsense stimuli seemed to have been a result of the failure to also include enough words of this type in the list of meaningful words.

Table 18 - A
Accuracy of Response in Decoding Meaningful and
Nonsense CVC Generalization Words

		Decoding response					
		Correct		Incorrect		None	
Stimulus type	n[a]	n	%	n	%	n	%
Meaningful	81	53	65	23	28	5	6
Nonsense	16	7	44	5	31	4	24

[a] Of the total 128 decoding generalization words, 26 cases were indeterminate since either the stimulus or the response may or may not have represented meaning for the child; an additional 5 words which appeared in an embedded context are also not included here.

Meaningfulness of Error Responses

Examination of the type of errors made to meaningful and nonsense stimuli (Table 19) indicates that, when incorrect, A. was more likely to make a meaningful response (61%) than a meaningless one (39%) to the 23 meaningful words which she decoded incorrectly. This was not the case with the few errors (5) made to nonsense syllables, all of which involved changes to meaning (e.g. "bæɔl" became "pʊl"). (See Appendix B for a complete list of these errors).

These results seem to suggest that meaningfulness was not a strongly salient cue for A.. This seems particularly to be the case for those CVC words which were presented in an isolated fashion; the few which appeared in an embedded context were all correct.

Table 19 - A
Type of Error Response in Decoding Meaningful and Nonsense CVC Generalization Words

		Error responses			
		Meaningful		Nonsense	
Stimulus type	n incorrect	n	%	n	%
Meaningful	23	14	61	9	39
Nonsense	5	5	100	0	0

Decoding Words in Context

Generalization words. The five CVC generalization words which were presented to A. in context were all responded to correctly. An additional seventeen generalization words were also presented in context; these were of varied configurations (e.g., "fast" is a CVCC). As Table 20 indicates, her accuracy on these 22 words was 73%, a slightly higher accuracy than was achieved on such words presented in isolation. This could suggest that the additional meaning cue supplied by context aided A's decoding. Of the six errors which did occur on embedded generalization words, only one could be considered an error syntactically related to the context in which the stimulus word appeared i.e., A. read "Ann taps" as "Ann tapped."

The other five errors bore no relationship to the context and were appropriate only in a grapho-phonemic manner; e.g., "bill slid on the mat" was read as "bill sild on the mat." This seems to suggest that context played only a minimal role in facilitating A's decoding when she was incorrect. She was apparently more attentive to the grapho-phonemic information supplied by the individual stimulus words than to the information supplied by the context in which these generalization words appeared.

Table 20 - A
Type of Error Response in Decoding Generalization Words of Varied Configurations Which Were Presented in an Embedded Context

			Error type					
	Correct		Grapho-phonemic		Syntactic		Grapho-phonemic-syntactic	
Total N	n	%	n	%	n	%	n	%
22	16	73	5[a]	23	0	0	1[b]	5

	Stimuli	Responses
[a]The errors were:	Ann ran fast.	Ann ran fat.
	Bill slid on the mat.	Bill sild on the mat.
	the is bl.	the is bill.
	put tript on the	pat tipt on the
	can add, can bill spell?	can add. can bill sell?
[b]The error was:	Ann taps.	Ann tapped.

Previously presented words. To further buttress the hypothesis that A. was not particularly aided by cues offered from context, an examination of her performance was made on "old" words which were presented to her in sentences. Very few of the errors which occurred can be considered to be syntactically or semantically appropriate. On 4/11, A read "s   and bill at sk l" (the title of a new story) as "s   and bill at camp"; she immediately followed this semantically apprpriate response with "kill," a response related to the graphemes of the stimulus words, but no longer syntactically appropriate. An error which seemed to rely on both syntactic and graphemic information was her decoding of "fat" as "fast" in "tim is fat." As has been noted, however, these errors were few in number.

The errors which were more commonly observed on contextually-embedded "old" words were related to the stimulus words only in a grapho-phonemic manner. Numerous examples of such errors were evident; two will suffice here. On 2/3 A read "Ann laft. is Ann mad?" as "Ann laft. is Ann mat?"; on 12/9 A read "is the man sad?", as "is the man "sat /s//a//d sad?" This latter example illustrates a tendency A.had to selfcorrect without examiner prompting: a number of times A. read a word in a sentence incorrectly, then immediately corrected herself, often relying on segmentation to do so. While it occurred quite often on errors made in context, this self-correction process was seldom observed with errors made on words which appeared in isolation. This seems to suggest that, while A. relied primarily on the grapho-phonemic information available, context supplied at least minimal cues that an erroneous response had been made.

The Development of Decoding and Encoding Strategies

The major strategy A. demonstrated in her decoding was evident during the first session on 11/15 and showed little modification. She immediately recognized the relationship between the auditory units (phonemes) and visual stimuli (graphemes) and used her segmentation and blending skills for decoding, with minimal experimenter intervention. Throughout the remaining 34 sessions she applied this sounding-out strategy consistently with little variation whenever she was presented with new words. That this strategy was her strategy, and not simply a question of playing by the "rules of the game" was clear: when the experimental intervention that she avoid the sounding-out approach was suggested, her decoding accuracy dropped. When she did not sound-out it was clear that she continued to rely on segmentation to aid her decoding of unfamiliar material; it was only with more familiar stimuli that she felt free to abandon its use, although the difference was not dramatic (she continued to use it at least half the time on material which had been presented previously). While A. initially demonstrated a decoding accuracy considerably higher than some other children in the program, she, unlike others, manifested only minimal improvement; it was clear that the facilitative effects of sounding-out were limited and would need to be abandoned eventually.

While few changes were evident in A.'s decoding strategies, encoding strategies were altered over the course of our sessions together. She used the sounding-out approach with encoding less frequently in her earlier sessions than she had with decoding, and increased its use in later sessions. Why she did so is unclear; while in earlier sessions she was more accurate when she had not sounded-out than when she had, she was only slightly more accurate in later sessions when segmentation was employed; this indicated only minimal facilitative effects from its use. The increased use of sounding-out on encoding may have been a result of its regular usage in decoding.

The present analyses suggest that A.'s primary difficulties were with vowels rather than consonants even though fewer vowels were included in the curriculum. When decoding CVC words, the vowel component tended to be incorrect as often as the final consonant; however, when it appeared in a final position (e.g., in the CCV) her error rate drastically increased due most likely, to an interaction of vowel difficulty and the less-saliant final position. In encoding it was also clear that the vowel was the least salient CVC component, evidenced by the regular omission rate.

Appendix A - A
Part-Whole (P-W) Instructional Sequence

Date	Consonants	Vowels	Sight words	Process
11/15	s			
		a		
	p			
11/18	t			
11/19	m			
11/29	d			
12/1			the	
12/8			is	
	n			
12/13		i		
1/10			on	
1/13	r			
	l			
1/24	f			
1/31	c			
2/3	b			
2/7	w			Not to "sound-out"
3/3	sh			
3/10	k			
4/4		e		
4/25				i/t/a to t.o. transition instructions

Appendix B - A
Decoding Error Responses to Meaningful and Nonsense CVC Generalization Words

Meaningful Words				Nonsense Words			
	Response type				Response type		
Stimuli	Meaningful	Nonsense	None	Stimuli	Meaningful	Nonsense	None
tap			✓	sas			✓
sam				pap	pop		
map	mop			tat			
pass	pack			pim			
pad	pat			lal	ôwl		
sad				faf			
mit		mt		fωt	fωd		
fill	full			bωl	pωl		
mass		maz		cet	cat		
bill	ball						
bat	bat						
rib		reb					
pωl	fωl						
cash		cish					
ship							
kit	kat						
shack		sheck					
kill		kull					
cωl	cow						
ten	tin						
pen							
bell	bill						
sed	sad						
set	sed						
pig	pik						
get		gat					
ham		nam					
jet		jat					

K

Introduction

Screening Test Performance

On the screening test, K. indicated a more complete knowledge of letter names than of sounds. He produced the names of all but two graphemes ("b" and "q") but produced the phonemic equivalents of only fourteen letters (13 consonants, one vowel). He recognized the sounds of an additional two symbols (1 vowel, 1 consonant). He was able to segment three initial consonants (out of four), but no vowels, and segmented the final phoneme less often, making occasional errors. He blended two two-bit words (e.g. /bi/ /t/ = "bit") and seemed hampered by the schwa (e.g., /b/ /it/ = "butted"); the other blends were incorrect, but included at least one of the stimulus phonemes. He demonstrated a good sight vocabulary by reading twelve of eighteen Durkin list words as well as all three words which he volunteered. K indicated some skill at encoding the Durkin words (but not those which he had volunteered), though he tended to reverse (e.g., "it" = ti), even on his own first name. The reversal problem was apparently linked to two factors: 1) he did not know "right" and "left," and 2) he believed that reading could progress from right to left.

Even though he indicated some knowledge of grapho-phonemic correspondences, K. believed that a written word could "say" more than one thing. He also thought that any sound (e.g., "thunder") could be written down. He was unsure of the difference between letters and numbers. K. could not identify word boundaries in either orally or visually presented sentences and confused "words" with "letters": when asked how many words were in a sentence appearing in front of him, he counted the letters instead.

Behavior and Disposition

Throughout our study, K. was cooperative and fully involved in the tasks presented to him. He was also very sensitive about his own successes and failures. Indeed, he reacted with ambivalence to his own success, on the one hand pleased but on the other hand apparently fearful that he had set up an expectation for success which he might be unable to meet in the coming "trial."

Treatment Implementation

Since K. demonstrated a strong sight vocabulary and was considerably weaker in his auditory skills, the decision was made to instruct him in a whole word approach (W-P). In the W-P method the child is never explicitly instructed in the 1:1 sound-symbol correspondence of the graphemic components of the written stimulus word. Rather, the child is taught only a series of words containing a number of different graphemes, and is then tested on his/her ability to extract the grapho-phonemic information from the learned words, and apply such information to decoding and encoding new words containing the same grapho-phonemic relationships. No instruction is given to the child to segment or "breakout" these relationships from the taught words. It should be noted that, for this reason, the label "decoding" in the W-P approach is somewhat misleading, and might better be called by another term such as "recognition" when the child is reading a word he has been taught; for the sake of consistency, the term decoding is retained here, with that qualification.

K.was introduced to fifteen consonants and four vowels (see Appendix C) in the course of the thirty sessions. In addition, several sight words (the, is, on), which were not composed exclusively of curricular graphemes, were also included to facilitate sentence construction.

Accuracy on Whole Words and Individual Components

Whole Word Accuracy

The preliminary analysis of average performance on decoding and encoding generalization words indicated that K.'s encoding skills were markedly superior to his decoding skills in the final period: whole word encoding was 68% correct while decoding was only 33% correct. Prior to 4/12 (the beginning of the final period), the reverse was true: decoding tended to be slightly more accurate than encoding. The striking improvement K. demonstrated in his encoding of whole words was not found in decoding; this suggests possible differences in approaches to the two tasks. The actual development of these two sets of skills have been traced separately below to examine these differences in greater depth. The original session-by-session tabulation of the data was collapsed into three periods which reflect changes apparent in K.'s performance accuracy levels and his development of segmentation in the encoding task.

Individual Component Accuracy

The analysis of K.'s decoding and encoding accuracy has been conducted on two levels, both of which involved a comparison of his accuracy for production of each of the three components of CVC's and changes over time. One analysis is concerned with production accuracy; the other involved production accuracy and positioning accuracy.

Production accuracy in decoding. (See Table 1) Accuracy of production of each of the three components of CVC's, when position was disregarded, ranged from 42% (for the C_2 in the second period) to 76% (for the C_2 in the third period). Improvement on the C_1 was evident, particularly from the first to the second period; C_2 improved most during the second to the third period; the V maintained the same production accuracy rate (slightly over 60%) in all three time periods. During the final period both consonants (C_1 and C_2) were decoded with greater accuracy than the vowel (C_2 was slightly more accurate than C_1). Thus, only moderate improvement characterizes K.'s decoding performance when production of individual components is considered.

Production and positioning accuracy in decoding. (See Table 2) When the accuracy of K.'s correct production of a phoneme was also considered in terms of his correct positioning of that phoneme in his response the following patterns emerged. In all three periods K. tended to produce a correct consonant (C_1 or C_2) in the correct rather than incorrect position more often than not, although this tendency was not strong. In a substantial proportion of cases, K. produced C_1 in the final position of his response, and, correspondingly, placed C_2 in the initial position of a response (although both of these errors did not necessarily occur in the same response). For example, when decoding the word "pin" K. responded "flap," and when reading "lap," K. said "pot." Also, when presented with "mac," K. read it as "cam." K.'s tendency to use C_1 at the end of a word or C_2 at the beginning of his response decreased steadily over time, while his tendency to produce the correct phoneme in the correct position was greater in the third than in the first

Table 1-K
Whole Word and Component Accuracy of CVC Decoding Words in Three Time Periods[a]

			Components of CVC									Whole word		
			C_1			V			C_2					
Time period	Total N		Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	No response
11/29-2/1	33	n	11	17	0	19	9	0	11	17	0	2	26	5
		%	33	52	0	58	27	0	33	52	0	6	79	15
2/11-4/1	19	n	8	8	0	10	6	0	4	12	0	3	13	3
		%	42	42	0	53	32	0	21	63	0	16	68	16
4/12-5/4	21	n	12	8	0	12	8	0	14	4	2	7	13	1
		%	57	38	0	57	38	0	67	19	10	33	62	5
11/29-5/4	73	n	31	33	0	41	23	0	29	33	2	12	52	9
		%	42	45	0	56	32	0	40	45	3	16	71	12

Note: If a correct component was used, but in the wrong position, it was counted as incorrect in this analysis.

[a] The three time periods correspond to the development of a segmentation strategy in encoding.

Table 2-K

Whole Word and Component Accuracy of CVC Decoding Words in Three Time Periods[a] without Regard to Positioning Errors

			Components of CVC									Whole word		
			C_1			V			C_2					
Time period	Total N		Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	No response
11/29-2/1	33	n	18	10	0	20	8	0	19	9	0	6	22	5
		%	55	30	0	61	24	0	58	27	0	18	67	15
2/11-4/1	19	n	14	2	0	12	4	0	8	8	0	4	12	3
		%	74	11	0	63	21	0	42	42	0	21	63	16
4/12-5/4	21	n	15	5	0	13	7	0	16	2	2	7	13	1
		%	71	24	0	62	33	0	76	10	10	33	62	5
11/29-5/4	73	n	47	17	0	45	19	0	43	19	2	17	47	9
		%	64	23	0	62	26	0	59	26	3	23	64	12

[a] The three time periods correspond to the development of a segmentation strategy in encoding.

period for both C_1 and C_2. The tendency to place either C_1 or C_2 in the middle position was slight or nonexistent for all three periods. The most apparent error pattern that K. exhibited was a tendency to produce a decoding response that began with C_2 or ended with C_1, or both, but this error pattern diminished over time.

Examination of vowel accuracy revealed that, while it was comparable to that of C_1 and C_2 (when positioning errors were disregarded), it was usually decoded in the correct (middle) position in all three time periods when the correct vowel was used. The vowel was never placed in the initial position and infrequently in the final position. The superiority of the positioning of the vowel, however, may be attributed to two factors: First, K.'s incorrect tendency to begin with C_2 or end with C_1 (i.e. reverse direction) would not affect the vowel since it would remain in the middle position regardless of the direction of responding. Second, K.'s performance may have been affected by a set for responding in syllables with a vowel in the middle, bordered by consonants. The limited number of vowels to which K. was exposed in the curriculum (four) could have facilitated the development of such a set. The fact that vowels are always in the second position in CVC's unfortunately confounds positioning skills with vowel skills. The few examples available of vowel performance in non-CVC configurations provides some evidence: K. correctly produced and positioned a non-second-position vowel only twice in four attempts.

Production accuracy in encoding. (See Table 3) When accuracy of selection of letter symbols in encoding was considered without regard to accuracy of placement, somewhat similar rates were observed for all three CVC components, although C_1 was slightly above V and C_2. The first set of abrupt changes emerged in the comparison of the first and second periods. While the accuracy rate improved moderately for the C_1 and V, it actually decreased for the C_2 (from 50% to 31%). The rate of accuracy in encoding the whole word remained at the same low level in both periods (6%). Thus, it seems reasonable to suggest that an attentional constraint was influencing K.'s performance such that increased efforts (or attention) to the encoding of C_1 apparently interfered with attention to encoding C_2. It is possible that K. chose to rely heavily on the C_1 cue because of its salience. Also, the disparity between the encoding accuracy of C_1 and C_2 may be linked to the develop-

Table 3-K
Whole Word and Component Accuracy of CVC Encoding Words in Three Time Periods[a]

			Components of CVC									Whole word		
			C$_1$			V			C$_2$					
Time period	Total N		Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	No response
11/29-2/1	18	n	8	8	0	2	11	3	3	11	2	1	15	2
		%	44	44	0	11	61	17	17	61	11	6	83	11
2/11-4/1	16	n	10	4	0	3	10	1	3	11	0	1	13	2
		%	63	25	0	19	63	6	19	69	0	6	81	13
4/12-5/4	25	n	24	1	0	21	3	1	21	4	0	17	8	0
		%	96	4	0	84	12	4	84	16	0	68	32	0
11/29-5/4	59	n	42	13	0	26	24	5	27	26	2	19	36	4
		%	71	22	0	44	41	8	46	44	3	32	61	7

__Note__: If a correct component was used, but in the wrong position, it was counted as incorrect in this analysis.

[a] The three time periods correspond to the development of a segmentation strategy in encoding.

ment of a strategy of overt "sounding-out" only the C_1 which K. exhibited about a third of the time in the second period.

In the third period K. showed an abrupt improvement in accuracy for C_2 and V, and additional improvement for C_1, such that he achieved high levels of accuracy on all three components. In this final period, K.'s accuracy level for C_1 was the highest; the improvement from the second to the third period was the most striking for C_2 (from 31% to 84%).

The same improvement which was evidenced for each of the three components was paralleled by a very marked improvement in the ability to encode an entire word correctly (from 6% in the first two periods, to 68% in the last period). Both sets of analyses suggest that K.'s approach to encoding had changed drastically from the second to the third period and, indeed, the very high rates of accuracy in encoding components of generalization CVC words suggests that K. had developed a new strategy that he used successfully in the final period.

Production and positioning accuracy in encoding. (See Table 4) While the accuracy rates of production of the three components does not suggest major differences among them, K.'s positioning errors for each of the three occurred at different rates. In the first period, K. tended to place a correct C_1 in the correct position more often than not; on two attempts when C_1 was correctly selected he placed it in the final position. In contrast, while he correctly selected the C_2 (50%) nearly as often as he had the C_1 (56%), he placed the C_2 in the correct (final) position only once; it was encoded in either a medial or initial position in the other attempts. The vowel was selected correctly somewhat less often (33%) than were the two consonants and usually mispositioned; on only two occasions was the vowel placed in a medial position. Once again, the vowel was often incorrectly placed in the initial position. It is clear, then, that during the earlier sessions, K. had a more developed strategy for C_1 encoding than he did for either the C_2 or V.

In the second period, the picture for C_1 remained essentially the same. As before, when incorrectly positioned (on two occasions), the C_1 was placed in a final position. The C_2 was correctly positioned on three of the five times it was cor-

Table 4-K
Whole Word and Component Accuracy of CVC Encoding Words in Three Time Periods[a] without Regard to Positioning Errors

			Components of CVC									Whole word		
			C_1			V			C_2					
Time period	Total N		Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	No response
11/29-2/1	18	n	10	6	0	6	7	3	9	5	2	1	15	2
		%	56	33	0	33	39	17	50	28	11	6	83	11
2/14-4/1	16	n	12	2	0	8	5	1	5	9	0	1	13	2
		%	75	13	0	50	31	6	31	56	0	6	81	13
4/12-5/4	25	n	24	1	0	21	3	1	21	4	0	17	8	0
		%	96	4	0	84	12	4	84	16	0	68	32	0
11/29-5/4	59	n	46	9	0	35	15	5	35	18	2	19	36	4
		%	78	15	0	59	25	8	59	31	3	32	61	7

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[a] The three time periods correspond to the development of a segmentation strategy in encoding.

rectly selected. No improvement on V positioning was evident during this period; while it was correctly selected eight times, only three encoding attempts included the V in the correct position.

In the final period K. exhibited startling improvement, not only in selection of the correct graphemes, but also in positioning skills. For all three components a correctly selected grapheme was consistently placed in the appropriate position. Thus K. had eliminated all positioning errors when the correct components of a CVC were chosen.

Consonant Position in Teaching Words and Reversed Responses to Generalization Words

K.'s C_1 and C_2 positioning errors, particularly in decoding, often occurred within the same word, such that a completely reversed response was given (e.g., "pan" read as "nap"). To ascertain whether this tendency may have resulted from a set induced through instructional materials, we examined the extent to which the teaching words more often exhibited particular consonants in the initial or final position (see Appendix C). Four of the consonants seem to have been instructed in a "biased manner": the teaching words containing "s" and "p" most often included these consonants in the initial position (e.g., sam), while "t" and "n" appeared most often in the final position (e.g., "man"). Inspection of the six complete reversals that K. made (Chart 1) did not reveal any tendency on K.'s part to put these four graphemes into the position in which they had initially been taught. There was, therefore, no evidence to suggest that his reversals of generalization words were a function of the position of particular letters in the teaching words.

Chart 1 - K

Examples of Reversal Errors

Date	Stimulus	Response
12/10	tan	nut
12/16	mat	tam
1/7	mit pit mip	tim tip pim
3/8	mac	cam

Overt Segmentation

Decoding

K. never approached the decoding task by overtly sounding-out a generalization word in Periods I and II (See Table 5-K). In Period III he used segmentation on only three out of 21 decoding generalization words. Because of the limited number of decoding words that K. segmented in all three periods, the relationship of segmentation to decoding accuracy is unclear.

Encoding

Frequency. K. sounded out the first consonant in only two words (the /r/ in ram and rap) when encoding in Period I (See Table 6-K). He sounded out parts of five generalizing words in Period II, segmenting C_1 the most often (36% of the time). In Period III, K. sounded out C_1, V, and C_2 92%, 76%, and 72% of the time, respectively. Indeed, there were only two words he did not segment at all in the final period: "b[illegible]n," which he encoded correctly, and "f[illegible]l", which he encoded as "fol." In addition, he sounded out all three phonemes of a single CVC generalization word for the first time on 4/12 (in Period III), when encoding "cab" and "c[illegible]n."

Accuracy. In Period I, the two instances of segmentation (both on C_1) led to correct selection of the grapheme whereas failure to segment C_1 resulted in correct selection only 50% of the time (See Table 6-K). In Period II, K. sounded-out C_1 five times and V three times; all these attempts led to correct selection of the grapheme, while on the other hand failure to segment resulted in a considerably lower accuracy rate of 57% for C_1 and 64% for V. The final consonant was segmented only once in Period II, and the correct grapheme was not selected subsequently. It appears, therefore, that in Period II, K.'s infrequent, overt segmentation exercised a facilitating effect on his encoding attempts.

By Period III, K. sounded-out all three CVC components most of the time. It seems reasonable to suggest that K. recognized the facilitative effects of his segmentation strategy in Period II and therefore used it rather consistently in Period III. His rate of accuracy for C_1 was only 84% correct with segmentation as compared to 100% correct without segmentation. However, the 100% figure based on only two examples is not as reliable a figure as the 84% and may also represent K.'s

Table 5-K

Frequency of Overt Segmentation and Relationship to Accuracy on Components of CVC Decoding Words in Three Time Periods[a]

					C_1				V				C_2			
					Segmented		Not segmented		Segmented		Not segmented		Segmented		Not segmented	
Time period		Total presentations	No response	Incorrect segment.	Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct
11/29-2/1	n	33	5	0	0	-	28	18	0	-	28	21	0	-	28	18
	%		15		0	-	85	64	0	-	85	75	0	-	85	64
2/11-4/1	n	19	3	0	0	-	16	13	0	-	16	12	0	-	16	9
	%		16		0	-	84	81	0	-	84	75	0	-	84	56
4/12-5/4	n	21	1	0	3	2	17	13	1	1	19	11	1	1	19	15
	%		5		14	67	81	76	5	100	90	68	5	100	90	79
11/29-5/4	n	73	9	0	3	2	61	44	1	1	63	44	1	1	63	42
	%		12		4	67	84	72	1	100	86	70	1	100	86	67

---

[a] The three time periods correspond to the development of a segmentation strategy in encoding.

Table 6-K
Frequency of Overt Segmentation and Relationship to Accuracy on Components of CVC Decoding Words in Three Time Periods[a]

					C_1				V				C_2			
					Segmented		Not segmented		Segmented		Not segmented		Segmented		Not segmented	
Time period		Total presentations	No response	Incorrect segment.	Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct
11/29-2/1	n	18	2	0	2	2	14	7	0	-	16	5	0	-	16	9
	%		11		11	100	78	50	0	-	89	31	0	-	89	56
2/11-4/1	n	14	2	1[b]	5	5	7	4	3	3	9	5	1[b]	0	11	5
	%		14		36	100	50	57	21	100	64	56	7	0	79	45
4/12-5/4	n	25	0	3[b]	23	21	2	2	19[b]	17	6	4	18[b]	15	7	6
	%		0		92	84	8	100	76	89	24	67	72	83	28	86
11/29-5/4	n	57	4	4[b]	30	28	23	13	22[b]	20	31	14	19[b]	15	34	20
	%		7		53	93	40	57	39	91	54	45	33	79	60	59

[a] The three time periods correspond to the development of a segmentation strategy in encoding.

[b] V was incorrectly segmented once in the 4/12-5/4 period; C_2 was incorrectly segmented once during the 2/11-4/1 period and twice during the 4/12-5/4 period.

ability to dispense with segmentation when he was very sure of the correct response.

The use of segmentation for V in Period III shows a clear facilitating effect on accuracy; K. reached a level of 89% correct with segmentation of the vowel, but achieved only 67% correct without segmentation. Finally, the presence or absence of segmentation on C_2 did not differentially affect accuracy in Period III.

Accuracy on Individual Consonants

Decoding

K. was exposed to a total of 15 consonants (in the context of teaching words) over the course of the 30 sessions. In decoding (See Table 7), general accuracy on the various consonants ranged from 40% (on the "d" and the "c") to 100% (on the "f" and the "k"). Total accuracy, based only on the actual number of errors divided by the total number of presentations was 62%; when adjusted for the number of presentations per consonant, this accuracy "dropped" slightly to 57%. (The latter figure is more appropriate for use in discussion, since the number of presentations varied considerably from one consonant to another.)

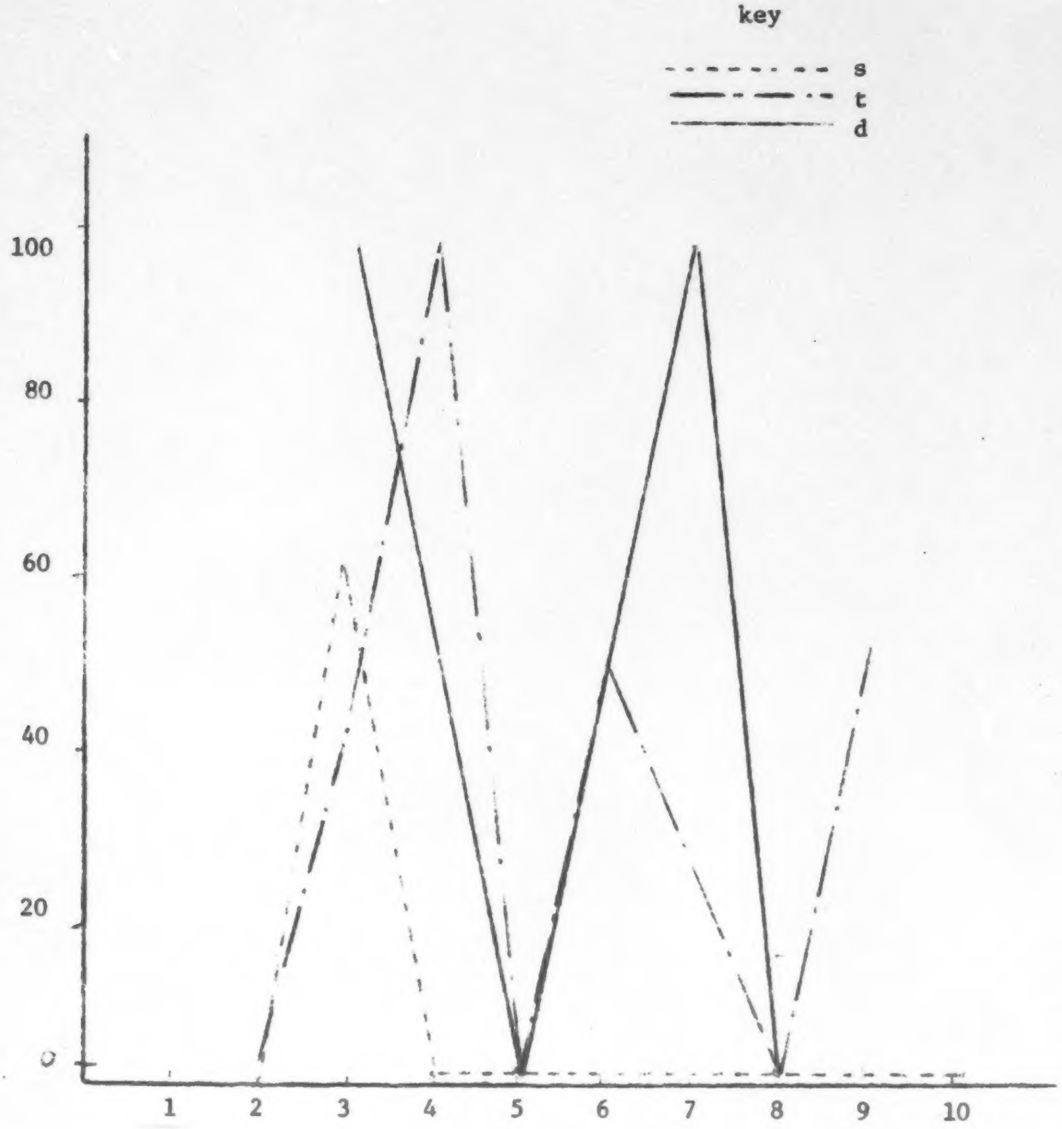
An inspection of the total accuracy of individual consonants initially suggested that those consonants introduced in the first sessions (s, m, p, t, n, d) may have been more difficult than those consonants introduced in the later sessions (r, c, l, b, f, sh, k, h); the average total accuracy for the earlier consonants is 58%, while the average total accuracy for the later consonants is 78%. However, an analysis of change over time revealed that this was not necessarily the case: After 2/1 (when the "r" was first introduced), the two consonant groups had average accuracy rates which were more similar (67% vs. 78%). In that the average accuracy rate for the initially presented consonants still appeared to be slightly lower, it was illuminating to examine the change in accuracy pattern for three of the initially presented consonants (s, t, and d). Figure 1 indicates the decoding accuracy overtime for these three consonants. As can be seen, the initial error rates were roughly similar for all three, each one reaching a high level of error at or towards the beginning of the period in which they were exposed. Overtime, however, the sudden and stable improvement on the "s" is in strong contrast to the less consistent treatment of the "d" and "t" which did not show this levelling-off at a low error

Table 7-K
Correct and Incorrect Decoding of Consonants in CVC Generalization Words: General Accuracy and Changes over Time

		All sessions					Over time			
		Total	Correct		Incorrect		11/29-1/24		2/1-5/4	
Consonant	Date of introduction	N	n	%	n omitted	n substituted	n presented	% correct	n presented	% correct
s	11/29	13	9	69	2	2	7	43	6	100
m	11/29	17	12	71	3	2	11	64	6	50
p	11/29	19	13	68	5	1	12	50	7	100
t	11/29	22	11	50	5	6	11	64	11	36
n	12/3	17	8	47	2	7	10	40	7	57
d	12/3	10	4	40	1	5	3	0	7	57
r	2/1	8	5	63	0	3	-	-	8	63
c	2/18	5	2	40	1	2	-	-	5	40
l	2/18	11	8	73	2	1	-	-	11	73
b	3/29	4	3	75	0	1	-	-	4	75
f	4/1	2	2	100	0	0	-	-	2	100
Sh	4/19	4	3	75	0	1	-	-	4	75
k	4/19	3	3	100	0	0	-	-	3	100
h	4/22	2	2	100	0	0	-	-	2	100
Σ	4/22	1	0	0	1	0	-	-	1	0

Figure 1 - K

Comparison of Error Rates on "s," "t" and "d" in
Responses to Decoding Generalization Words
In Several Consonant Phases[a]



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[a] "Consonant phases" refer to one or more sessions marked by the introduction of at least one consonant in the first session of the phase.

rate. Why might this be the case?

While we have little basis in K.'s case to make a clear argument for the existence of any of the more common error types, we can only suggest that the d/t voiced-voiceless articulatory error might have been marginally operative, contributing to the lack of consistent improvement on either of these consonants. It is noteworthy that about half the errors made on those two consonants involved the substitution of one for the other. Although the observed errors did not fall into any clearly discernible category, 90% of the consonant errors in decoding involved the substitution of a previously taught grapheme for the stimulus grapheme or phoneme. While the encoding task is constricted by the availability of letters from which to choose, the decoding task has no such constraint. It is for this reason that such an error pattern is particularly remarkable, in the decoding tasks. Any explanation offered must recognize the role played by the instructional method which, in K.'s case, was a whole word (W-P) approach. The fact that nearly all of K.'s errors represented the substitutions of taught letters is evidence of the fact that he had yet to develop a strategy for successfully extracting the appropriate sound-symbol correspondences, but was basing his guesses on the visual configurations which he had been taught.

Encoding

In encoding (See Table 8), general accuracy on the various consonants ranged from 30% (on the "l") to 100% (on the "b," "f," "k," and "h"). Total accuracy, based only on the actual number of errors divided by the total number of presentations was 63%; when adjusted for the number of presentations per consonant, this accuracy rate remained at the same level.

A comparison of changes in accuracy rate over time indicated that four of the six consonants introduced in the sessions through 1/24 improved. One remained at the same low accuracy level ("t") while one actually dropped in accuracy (the "n"). Every consonant error made in the encoding task involved a similar pattern observed in decoding: a substitution of a previously-taught grapheme for a stimulus-phoneme. It should be noted, however, that the encoding task is usually constricted by the

Table 8-K
Correct and Incorrect Encoding of Consonants in CVC Generalization Words: General Accuracy and Changes over Time

		All sessions					Over time			
		Total	Correct		Incorrect		11/29-1/24		2/1-5/4	
Consonant	Date of introduction	N	n	%	n omitted	n substituted	n presented	% correct	n presented	% correct
s	11/29	13	9	69	2	2	7	57	6	83
m	11/29	14	8	57	3	3	7	29	7	86
p	11/29	8	5	63	1	2	4	50	4	75
t	11/29	6	2	33	1	3	3	33	3	33
n	12/3	9	6	67	1	2	5	80	4	50
d	12/3	13	4	31	1	8	2	0	11	36
r	2/1	6	5	83	0	1	-	-	6	83
c	2/18	7	4	57	1	2	-	-	7	57
l	2/18	10	3	30	2	5	-	-	10	30
b	3/29	5	5	100	0	0	-	-	5	100
f	4/1	6	6	100	0	0	-	-	6	100
Sh	4/19	3	2	67	0	1	-	-	3	67
k	4/19	2	2	100	0	0	-	-	2	100
h	4/22	5	5	100	0	0	-	-	5	100
≤	4/22	3	3	100	0	0	-	-	3	100

availability of letters from which to choose.

Comparison of Decoding and Encoding

The relative ranking by accuracy of the consonants in the encoding vs. decoding tasks was roughly similar, such that those consonants which he more often misread in the decoding tasks were also lower in accuracy in his encoding (e.g. "s"). For any one consonant there was no general tendency to be higher in accuracy in encoding or in decoding; about half the consonants (i.e., p, n, c, r, b, s) were more accurately encoded and the other half were more accurately decoded (i.e., t, l, d, m, sh).

An interesting comparison was made between encoding and decoding over time. Breaking down the 30 sessions into 10 phases corresponding to the introduction of new consonants, we can trace the patterns of improvement in the two tasks. (See Figure 2). While both the encoding and decoding were very accurate in phase 2 when only four consonants (i.e., p, m, s, t) were in use, when new material was introduced in phases 3 through 7, performance deteriorated. K's decoding accuracy remained fairly consistent, at about 70% throughout the remaining sessions. His encoding of the consonants, however, reached a point of 67% error by the time he had been exposed to 9 consonants (phase 5). However, after phase 8, though he had now been taught words containing 12 different consonants, his encoding error rate decreased steadily, despite the continued introduction of new material.

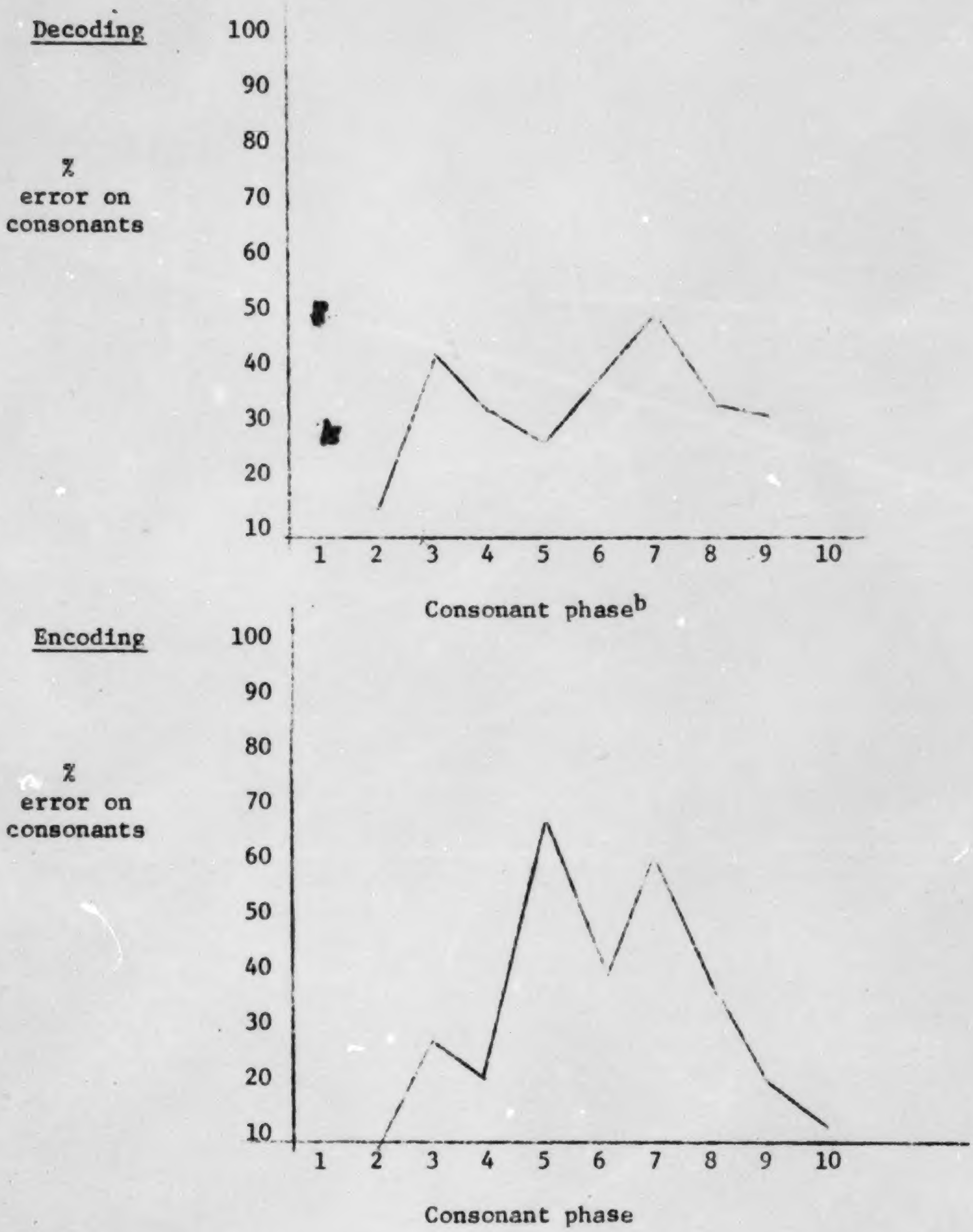
Thus, while the encoding of consonants was initially more difficult for K. than the decoding, K's encoding improved markedly, finally reaching an accuracy level of 88% (phase 9) while his decoding remained at a 69% level of accuracy in phase 10.

Accuracy on Individual Vowels

K. was taught a total of four vowels, all within the context of whole words rather than as individual phonemes. These vowels were 'a,' 'i,' u ,' and 'e,' and were presented initially on 11/29, 1/7, 4/1 and 4/19 respectively. For the purposes of analysis, the original session-by-session tabulation of the data was collapsed into periods which reflect the dates on which new vowels were introduced

Figure 2 - K

Comparison of Error Rate on Consonants in Decoding and Encoding Generalization Words in Several Consonant Phases[a]



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[a] "Consonant Phases" refer to one or more sessions marked by the introduction of at least one consonant in the first session of the phase.

[b] Phase 10 has been eliminated from the decoding group because only two generalization words were presented in those sessions.

(See Table 9-K). This was done in order to monitor the development of new strategies, which, if actually established, would presumably be evident in the child's decoding and encoding attempts on new vowel material. Clearly, encoding and decoding attempts on old material, even in new contexts, are confounded by the effects of practice and cannot be considered evidence of a new strategy when examined alone. Indeed, patterned approaches to new materials in new contexts provide the strongest evidence of "generalization," which we consider to be "proof" of the establishment of a strategy.

Decoding

From the first session on 11/29 through 1/6, the only vowel to which K. had been exposed was "a." He correctly produced it 46% of the time (See Table 9-K). The majority of his errors were attributable to either omission of the vowel or failure to decode the word. In the following period from 1/7 through 3/29, when K. had been taught only the "a" and "i," in whole words, his performance on "a" remained at the same level, while his use of the "i" reached a level of 88% correct. The superior performance for the "i" could conceivably be the result of a strategy for processing vowels in general which had not been established when the "a" was initially presented. If so, then his performance on the "a" should have improved to about the same accuracy level as that of the "i," from the time that the "i" was introduced. The fact that performance on the "a" did not improve and that performance on the "i" was so much higher suggested that an /i/ response set was operating. Indeed, from 1/7 to 3/29, K. decoded the "a" as /i/ 15% of the time.

After the third and fourth vowels (u and e) were introduced, use of the "a" improved to 60% correct, and use of the "i" remained at about the same level (83% correct). Again the high level for "i" was due in part to an /i/ response set; he substituted /i/ for /a/ 20% of the time, for /u/ 25% of the time, and for /e/ 50% of the time. K.'s ability to use the two new vowels in decoding tasks was quite limited; he produced the /u/ with 13% accuracy and the /e/ with 50% accuracy. His inability to master the new vowels rapidly, and the only slight improvement on one of the two earlier vowels suggest that he had not developed an efficient strategy

Table 9-K
Accuracy of Vowel Decoding in CVC Words in Four Time Periods[a]

		Stimuli																											
		a							i														e						
		Responses																											
Time period		a	i		e	other	schwa omit	n.r.	i	a		e	other	schwa omit	n.r.		a	i	e	other	schwa omit	n.r.	e	a	i		other	schwa omit	n.r.
11/29-1/6	n	6	0	1	0	0	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	46	0	8	0	0	15	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/7-3/29	n	6	2	0	2	1	1	1	21	1	0	0	0	0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	46	15	0	15	8	8	8	88	4	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4/1-4/15	n	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	2	0	3	0	2	-	-	-	-	-	-	-
	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	0	25	0	38	0	25	-	-	-	-	-	-	-
11/19-5/4	n	3	1	0	0	1	0	0	5	0	0	0	0	1	0	-	-	-	-	-	-	-	2	0	2	0	0	0	0
	%	60	20	0	0	20	0	0	83	0	0	0	0	17	0	-	-	-	-	-	-	-	50	0	50	0	0	0	0
11/29-5/4	n	15	3	1	2	2	3	5	26	1	0	0	0	1	2	1	0	2	0	3	0	2	2	0	2	0	0	0	0
	%	48	10	3	6	6	10	16	87	3	0	0	0	3	7	13	0	25	0	38	0	25	50	0	50	0	0	0	0

[a] The four time periods correspond to the introduction of each of the vowels into the curriculum.

Table 10-K
Accuracy of Vowel Decoding in CVC Words in Three Time Periods[a]

	Stimuli	a							i														e						
Time period	Responses	a	i		e	other	schwa omit	n.r.	i	a		e	other	schwa omit	n.r.		a	i	e	other	schwa omit	n.r.	e	a	i		other	schwa omit	n.r.
11/29-2/1	n	7	0	1	2	0	3	4	14	1	0	0	0	0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	41	0	6	12	0	18	24	88	6	0	0	0	0	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11-4/1	n	5	2	0	0	1	0	1	7	0	0	0	0	0	1	0	0	0	0	1	0	1	-	-	-	-	-	-	-
	%	56	22	0	0	11	0	11	88	0	0	0	0	0	12	0	0	0	0	50	0	50	-	-	-	-	-	-	-
4/12-5/4	n	3	1	0	0	1	0	0	5	0	0	0	0	1	0	1	0	2	0	2	0	1	2	0	2	0	0	0	0
	%	60	20	0	0	20	0	0	83	0	0	0	0	17	0	17	0	33	0	33	0	17	50	0	50	0	0	0	0
11/29-5/4	n	15	3	1	2	2	3	5	26	1	0	0	0	1	2	1	0	2	0	3	0	2	2	0	2	0	0	0	0
	%	48	10	3	6	6	10	16	87	3	0	0	0	3	7	13	0	25	0	38	0	25	50	0	50	0	0	0	0

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[a] The three time periods correspond to the development of a segmentation strategy in encoding.

for dealing with vowels in decoding.

Encoding

Between 11/29 and 1/6, K. correctly selected the "a" only once (20% of the time) in encoding, but by 3/29 he was using it correctly 43% of the time. Between 1/7 -- when the "i" was introduced -- and 3/29, K. selected the "i" correctly 37% of the time. He often selected the "a" in place of the "i" during that period.

In the following period (between 4/1 and 4/15) K's selection of the "a" jumped to 100% correct and remained at that level in the final sessions (from 4/19 to 5/4). His rate of accuracy reached 75% correct for the "i" in the final sessions as well.

While the sudden improvement in encoding "a" and "i" provided some evidence for the evolution of an encoding strategy, such evidence could not be considered conclusive since the improvement in encoding might have been due to practice effects. However, K. was able to encode a new vowel (ω) correctly 71% of the time during the first three sessions in which he was exposed to that vowel (from 4/1 through 4/15). Within two more sessions (4/19 - 5/4) he had reached a level of 100% accuracy on the "ω". In addition, K. was "taught" the "e" on 4/19 and within three sessions achieved an 86% level of accuracy. This ability to encode new vowels in novel contexts with a high degree of accuracy after only brief exposure to these vowels indicates that K. used a strategy for dealing with vowels in the encoding task. His improvement on "a" and "i" can also be attributed to use of a strategy rather than to the effects of practice alone.

The Role of Meaning

Decoding

Accuracy on meaningful and nonsense generalization words. As noted earlier, while only meaningful words were taught, both meaningful and nonsense words were presented to the children for generalization in order to determine their differential effects on the process of learning to read. Of the 73 generalization words with which K. was presented for decoding, eight could not be classified as either meaningful or nonsense words. The remaining 65 words (See Table 13) were classified as meaningful (56) or meaningless (9). K. responded correctly to ten meaningful words (18%) and only one nonsense word (11%). While the error rates for the

Table 11-K

Accuracy of Vowel Encoding in CVC Words in Four Time Periods[a]

		Stimuli																											
		a							i							(a)							e						
		Responses																											
Time period		a	i	(a)	e	other	schwa omit	n.r.	i	a	(a)	e	other	schwa omit	n.r.	(a)	a	i	e	other	schwa omit	n.r.	e	a	i	(a)	other	schwa omit	n.r.
11/29-1/6	n	1	0	0	0	1	0	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	20	0	0	0	20	0	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/7-3/29	n	3	0	0	0	2	0	2	7	3	0	0	3	0	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	43	0	0	0	29	0	29	37	16	0	0	16	0	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4/1-4/15	n	3	0	0	0	0	0	0	0	0	0	0	1	0	0	5	0	0	0	2	0	0	-	-	-	-	-	-	-
	%	100	0	0	0	0	0	0	0	0	0	0	100	0	0	71	0	0	0	29	0	0	-	-	-	-	-	-	-
4/19-5/4	n	3	0	0	0	0	0	0	3	0	0	1	0	0	0	3	0	0	0	0	0	0	6	0	0	0	0	0	1
	%	100	0	0	0	0	0	0	75	0	0	25	0	0	0	100	0	0	0	0	0	0	86	0	0	0	0	0	14
11/29-5/4	n	10	0	0	0	3	0	5	10	3	0	1	4	0	6	8	0	0	0	2	0	0	6	0	0	0	0	0	1
	%	56	0	0	0	17	0	28	42	13	0	4	17	0	25	80	0	0	0	20	0	0	86	0	0	0	0	0	14

[a] The four time periods correspond to the introduction of each of the vowels into the curriculum.

Table 12-K
Accuracy of Vowel Encoding in CVC Words in Three Time Periods[a]

		Stimuli																											
		a							i														e						
		Responses																											
Time period		a	i		e	other	schwa omit	n.r.	i	a		e	other	schwa omit	n.r.		a	i	e	other	schwa omit	n.r.	e	a	i		other	schwa omit	n.r.
11/29-2/1	n	1	0	0	0	3	0	3	2	3	0	0	3	0	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	14	0	0	0	43	0	43	18	27	0	0	27	0	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11-4/1	n	4	0	0	0	0	0	2	5	0	0	0	1	0	3	0	0	0	0	1	0	0	-	-	-	-	-	-	-
	%	67	0	0	0	0	0	33	56	0	0	0	11	0	3	0	0	0	0	100	0	0	-	-	-	-	-	-	-
4/12-5/4	n	5	0	0	0	0	0	0	3	0	0	1	0	0	0	8	0	0	0	1	0	0	6	0	0	0	0	0	1
	%	100	0	0	0	0	0	0	75	0	0	25	0	0	0	89	0	0	0	11	0	0	86	0	0	0	0	0	14
11/29-5/4	n	10	0	0	0	3	0	5	10	3	0	1	4	0	6	8	0	0	0	2	0	0	6	0	0	0	0	0	1
	%	56	0	0	0	17	0	28	42	13	0	4	17	0	25	80	0	0	0	20	0	0	86	0	0	0	0	0	14

[a] The three time periods correspond to the development of a segmentation strategy in encoding.

two word types were similar, there was a slightly greater tendency to give no response to nonsense words (22%) than to meaningful words (11%).

Meaningfulness of error responses. The major analysis of these data concerns changes to meaning (or nonsense) in incorrect responses. Our prediction, that when decoding incorrectly a child would tend to give a meaningful response to both meaningful and nonsense stimuli was borne out by the data (See Table 14). When responding incorrectly to a meaningful stimulus, K. gave a meaningful response 80% of the time and a nonsense response 20% of the time, showing a strong tendency to produce a meaningful response. When responding incorrectly to the nonsense word, K. produced a meaningful response 67% of the time, and a nonsense response 33% of the time. Thus, regardless of the type of stimulus, K.'s errors tended to result in meaningful responses. However, it is not clear why the tendency to do so was more marked for meaningful than for nonsense stimuli. The difference may be due to the relatively small number of nonsense stimuli presented, since no pattern of error distinguishes K.'s incorrect responses to the meaningful stimuli from those to the nonsense stimuli. Indeed, K. made errors on the first consonant or on the vowel or on the final consonant as often on meaningful or nonsense words. Examples of these follow: given the word "rip" K. read it as "zip," and given the word "nim," K. read it as "mim," thus incorrectly decoding the first consonant of both meaningful and nonsense CVC's; K. misread "nat" as "nut," and read "dat" as "did," thus erroneously decoding the medial vowel in both a meaningful and nonsense word; finally, when given "pat," K. read it as "pam" and also read "tid" as "flit," inappropriately decoding the final consonant in both meaningful and nonsense stimuli. (For a complete listing of these errors, see Appendix A).

In summary, the nature of the stimulus word, be it meaningful or nonsense, had only a minimal effect on the accuracy of K.'s decoding responses. However, his incorrect responses were predominantly meaningful; and this tendency was stronger when the previously unseen stimulus was meaningful. Thus while his error responses gave evidence of his expectation that the stimulus word would be meaningful, the fact that a word was, indeed, meaningful had a minimal effect on the accuracy of his decoding.

Table 13 - K

Accuracy of Response in Decoding Meaningful and Nonsense CVC Generalization Words

		Decoding Response					
		Correct		Incorrect		None	
Stimulus Type	n[a]	n	%	n	%	n	%
Meaningful	56	10	18	40	71	6	11
Nonsense	9	1	11	6	67	2	22

[a] Of the total 73 decoding generalization words, 8 cases were indeterminate since either the stimulus or the response may or may not have represented meaning for the child.

Table 14 - K

Type of Error Response in Decoding Meaningful and Nonsense CVC Generalization Words

		Error Response			
		Meaningful		Nonsense	
Stimulus Type	n incorrect	n	%	n	%
Meaningful	40	32	80	8	20
Nonsense	6	4	67	2	33

Encoding

The nature of the encoding, as opposed to the decoding task imposes limitations on the types of analyses that can be performed to examine the role of meaning. That is, when the child incorrectly encodes a word, there is no reasonable criterion for judging whether the encoding response is with or without meaning. For example, if a child encodes "cat" as "cas," there would be no reason to judge his response as nonsense, since the child thought he had encoded the word "cat." By the same token, the child might incorrectly encode "cat" as "can" and, simply as a function of chance, the response would be scored as meaningful. However, when the stimulus is correctly encoded, then its meaningfulness is a direct function of the type of stimulus presented, since it is the stimulus alone which can be considered either meaningful or not.

In light of the above, the only reasonable analysis to perform is to examine encoding accuracy for the two types of stimulus words. Unfortunately, such an analysis is limited in K.'s case. The session-by-session tabulation of the data on K.'s encoding indicated clearly that from 11/29 to 4/1, K. only rarely encoded a single word correctly. However, on 4/12 and thereafter, his encoding accuracy reached 68%. But since after 4/12, he was asked to encode only two nonsense words, (both of which he encoded correctly) no comparison of the accuracy of encoding nonsense and meaningful stimuli was possible. Thus, while the final instructional period (4/12 on) reflected a substantial improvement in encoding accuracy, it is not possible to judge whether the meaningfulness of the stimulus affected the results. Table 15 should, therefore, be interpreted with caution.

Table 15 - K

Accuracy of Response in Encoding Meaningful and Nonsense CVC Generalization Words

		Encoding Response					
		Correct		Incorrect		None	
Stimulus Type	n[a]	n	%	n	%	n	%
Meaningful	38	16	42	19	50	3	8
Nonsense	13	2	15	10	77	1	8

[a] Of the total 59 encoding generalization words, 8 cases were indeterminate since the stimulus may or may not have represented meaning for the child.

At the time that K. exhibited sharp improvement in encoding accuracy, he concurrently began to exhibit an overt encoding strategy, in which he orally segmented the entire stimulus word. For example, on 4/12 K. correctly encoded the word "roof" by segmenting each phoneme and selecting the appropriate letter, beginning with /r/ and ending with /f/. In addition, when correctly encoding the two nonsense words which had been presented to him after 4/12, (hez and shab), K. segmented the separate phonemes in each word before encoding.

The Development of Decoding and Encoding Strategies

A Comparison of Decoding and Encoding Accuracy

As noted earlier, the only clear pattern of improvement in K.'s decoding performance was found in his steadily decreasing tendency to use C_1 in final position and C_2 in initial position. However, while he continued to make positioning errors for C_1, V, and C_2 in decoding, these errors disappeared completely in Period III encoding attempts.

K.'s encoding performance in Period III surpassed that of decoding on other levels as well. When each CVC component was considered for accuracy with as well as without regard to position (see Tables 1-K, 2-K, 3-K, and 4-K), K.'s encoding skills were consistently superior to his decoding skills. In addition, his ability to encode a word with complete accuracy surpassed his ability to decode with complete accuracy. His ability to encode previously unknown words in Period III not only was superior to his decoding ability but also reached high levels of accuracy for all three CVC components. Both accomplishments suggest that K. had developed a more efficient strategy for encoding than for decoding.

Consonants and Vowels

K.'s performance both on the second set of consonants and on the last two vowels (æ and e) indicates that he used a fairly efficient strategy in encoding which he did not or could not use in decoding. Indeed within a brief period of time he was able to master the use of the second set of consonants in encoding generalizing words, but did not achieve the same high levels of accuracy for those consonants in decoding generalizing words. In the same manner, K. was able to encode the last two vowels (æ and e) with a high degree of accuracy after only brief exposure, but decoded them with limited success.

The Development of an Encoding Strategy Based on Segmentation

Since subjects in the whole-to-part approach (W-P) were never taught to break out parts of whole words, their use of an observable "sounding-out" approach constituted a self-evolved strategy which was carefully traced in this study.

Segmentation of Overlearned Words

K.'s use of an observable sounding-out strategy in encoding appeared on a generalizing (unknown) word for the first time on 2/1 at the end of Period I but not before Period III in decoding. However, the beginning of a sounding-out approach in both decoding and encoding was evident much earlier on words that K. had already encountered repeatedly. On 12/10 he sounded out the /s/ when decoding the word "sat," a word he had previously been taught and had read correctly several times. On 12/16, he sounded out the /t/ when encoding "tan" and "ta," words which he had seen previously. There were few other examples of some segmentation attempts in encoding and decoding until 3/18, when K began to segment his old words more frequently, especially when encoding. Indeed, on 3/18 K. sounded out all three phonemes of a single CVC for the first time, but he did this when encoding a rather familiar word -- "sam" -- the very first word K. had been taught and had met frequently since then. It was in the following session that K. segmented all three phonemes in a generalizing word (sil) for the first time. The fact that K. first used a new strategy on overlearned material may actually have been due to a need to "test out" and verify the effectiveness of the strategy by checking the results against the correct answer which he already knew.

Segmentation of Generalizing Words

K.'s beginning use of segmentation on Period II generalizing words and the prevalence of segmentation on Period III generalizing words appear to be linked directly to his sharp improvement in encoding evident in Period III. Indeed in Period II K.'s segmentation of C_1 and V led to improved performance on those components. No segmentation occurred on generalizing words for decoding in that period. Perhaps his success in Period II on segmented components convinced him of the expedience of segmentation, since he segmented all three components most of the time in the next period (Period III). When encoding and decoding accuracy levels in Period III are compared for each component, the largest discrepancies emerge for C and V, both of which were encoded with greater success than they were decoded. Interestingly, in Period II these were the components that were most often segmented and that showed superior encoding when segmentation did occur. Again in Period III, these were the most frequently segmented components in encoding and performance on the vowel co-occurred with the use of segmentation.

There is, therefore, reason to believe that the considerable improvement in encoding accuracy which K. exhibited in Period III, and by contrast, the lack of a corresponding increase in decoding accuracy, was directly linked to K.'s new use of an overt "sounding-out" strategy in encoding.

Appendix A - K

Decoding Error Responses to Meaningful and Nonsense

CVC Generalization Words

Meaningful words				Nonsense words			
	Response type				Response type		
Stimuli	Meaningful	Nonsense	None	Stimuli	Meaningful	Nonsense	None
tap			*	tat	nɷd		
pas			*	nam	mad		
tan	nut			pap			*
mat	tam			dit			*
mass		smaj		min	sin		
pan	tam			mip		pim	
nip		pim		nim		mim	
mit	tim			rad	ted		
pit	tip						
sip	zip						
tin	tim						
did		mim					
pin	flap						
sis	sin						
pad	pan						
sad	sed						
ran	ren						
rat	run						
rim	tim						
rip	zip						
dam	rid						
sil	slid						
till			*				
lit	slid						
lip		plid					
lap	pot						
tac			*				
tic	did						
bad	bat						
rip	rib						
sɷn		soɷn					
rɷm			*				
mɷn			*				
bɷt	bit						
rɷd		drit					
sɷt	sœ						
pɷl	pot						
rɷt	sɷt						
fiʒh	finz						
ship	push						
cash		shat					
kill	milk						
let	lit						
ten	lend						
neck	sick						
haʏ		ha					
hav	grɜɔv						

Appendix B - K

Encoding Error Responses to Meaningful and Nonsense CVC Generalization Words

Meaningful words		Nonsense words	
Stimuli	Encoding responses	Stimuli	Encoding responses
mat	m	nam	nia
map	(none)	tas	ta
miss	snt	sim	pas
dim	pma	nim	(none)
dip	pin	pip	mp
sin	sini	tis	snr
ram	rmn	nin	nn
rap	rpm	ris	maa
rid	iar	lat	nra
lid	oni	tid	til
mill	mni	bap	mdb
lick	(none)		
pill	(none)		
fin	fnn		
mωd	mod		
ban	bad		
fωl	fol		
cωn	cr		
cωl	kωco		
fωd	fωk		
hem	hm		
hiʒ	heʒ		

Appendix C - K

List of Teaching Words

Date	Words
11/29	sam pat
12/3	pam and
12/6	on
12/10	tap
12/16	the mat
12/17	man is
1/6	at mad
1/7	tim sit tin tω
1/13	did
1/20	pin
2/1	ran
2/18	cat sil lam

Date	Words
3/29	bit
4/1	in flω
4/12	mωn
4/15	sωt pωl
4/19	fish cash kit let
4/22	hω has

M

Introduction

Screening Test Performance

On the screening test, M. supplied eleven of the letter names and pointed correctly to an additional three graphemes when the examiner said the letter name. His knowledge of corresponding sounds, however, was rather limited: he correctly produced the sounds of only four graphemes (j,v,z and c) and could recognize the sounds of an additional three (f, t, and l). He also called the "q" a "p" and gave it the /p/ sound.

While his knowledge of phono-graphemic correspondences was minimal, M.'s blending and segmentation skills were outstanding. He correctly blended eight of the nine items on the blending section of the screening test. In the segmentation tasks, he generally produced the correct initial phoneme, tended to give the correct final syllable as the final phoneme, and was able to isolate many middle phonemes--which are considered the most difficult to segment.

M. exhibited some spatial orientation difficulties, confusing both the d and the p with the b on the letter-matching section. He never mismatched a whole word with the same word improperly ordered from right to left or upside-down. However, he had minimal knowledge of conventions about the direction of lines of print. He organized his full name by placing his last name on the left, his middle name to the right of it, and his first name to the right of his middle name. In addition, he indicated on a printed page that one reads by first scanning the bottom line from right to left and then the line above it from left to right, proceeding upwards in the same boustrophedon fashion. M. was also able to recognize the word "big" correctly when written in small letters, and the word "red" when written in blue.

Behavior and Disposition

M. was a rather playful, cheerful, and gregarious child who initially treated the reading task with nonchalance. However, once a reinforcement system was temporarily instituted to emphasize the importance of treating the task with seriousness, M. not only improved in his performance but also developed a new sensitivity to the success and failure of his own attempts. He began to engage eagerly in the decoding and encoding tasks and appeared to derive a sense of satisfaction and pleasure from his progress.

Treatment Implementation

Though M. could well have been placed in any of the three treatment groups, he was assigned to the whole-word (W-P) group because of his limited knowledge of phono-graphemic correspondences. While all the other children chosen for the study demonstrated knowledge of at least 12 such correspondences, M. was nonetheless included in the study because of his exceptionally good repertoire of reading-related skills which presumably would compensate for his minimal knowledge of letter sounds.

Like the other child in the whole-word or whole-to-part approach, M. was taught the sound equivalent of whole words. However, he was never explicitly taught the sound equivalent of single graphemes, nor was he told to segment sounds from whole words. For the first two and a half months, M. showed great difficulty in discriminating among the whole words explicitly taught to him. Consequently, few generalization words were presented to him during that time. This initial period of time--from 11/29 through 2/15 --constituted Period I and will be discussed below as a separate section. The "a" was introduced in the context of a whole word on the first day of Period I and was the only vowel used in that period.

Period II began with the introduction of the second curricular vowel (i) on 2/18 and extended through 4/12. In the following session (4/15), the third curricular vowel (u) was introduced, thus marking the beginning of Period III. The fourth vowel (e) was presented on the final session of Period III. M's progress in Periods II and III will be discussed in terms of accuracy in encoding and decoding, difficulties with consonants and vowels, the role of meaning, and emerging strategies.

Period I Performance

Initial Performance on Taught Words and Generalization Words (11/29-1/7)

Decoding. Since M. did not come to the reading task with a set of previously learned phono-graphemic correspondences, nor was taught any of them in a direct manner, it is not surprising that he was initially unable to distinguish the first few words he was taught. The visual components of the words served as very minimal cues to the appropriate sounds (or sound) of the word, perhaps because M. was not aware that they actually were cues, and not arbitrary configurations representing words.

Thus, for example, in the first session (11/29) M. was taught the words "sam" and "pat" and at the beginning of the second session (12/3) he was taught the word "pam". In the remainder of that session M. read "sam" correctly once out of five times, and otherwise confused it with "pat" (or failed to respond): he read "pat" correctly two out of six times, confusing it with both "sam" and "pam", and read "pam" correctly only once out of seven times, confusing it with both "sam" and "pat". Two sessions later (12/6) and after practice with those three words, he read "sam" correctly 11 out of 13 times, confusing it twice with "pam," read "pat" correctly only six out of ten times, confusing it with "pam", and read "pam" correctly only seven out of 13 times, confusing it with both "sam" and "pat".

Although on 12/6 M. showed an accuracy rate not much greater than chance with two out of the first three words taught to him, we did present him with two generalizing words for decoding on 12/13. He read "pap" as "tickle", and "tas" as "pat". Thus M.'s limited use of cues in decoding both taught and unknown words precluded the presentation of additional generalization words at this point.

In the next four sessions (through 1/7), M. was taught a few more words (sap, tap, pas, and, on) but no generalizing words were presented. Even by 1/7, M. had not yet achieved great accuracy with the words "sam", "pat", and "pam" nor with the other new words. He still confused "sam", "pat", and "pam" with each other, decoding "sam" correctly eight out of ten times, "pat" correctly six out of eight times, and "pam" correctly only two out of five times.

Encoding. A somewhat systematic approach, in which M selected at least one correct consonant, emerged earlier in his encoding than in his decoding. For example, as early as 12/13 he encoded "pas" as "psm", "sas" as "spc", "sa" as "sap", "mam" as "mtr", "am" as "mr", and "ta" as "tap". On 12/16, he encoded "map" as "mns", and on 12/17 he encoded "tam" as "tap". It should also be noted that often when encoding, M. first said the letter name before selecting the letter, a practice which we encouraged through positive reinforcement.

Reinforcement (1/13-2/8)

From the beginning, M. appeared to believe that the correctness of his response was unimportant, and he enjoyed the sessions despite his frequent errors. Although he applauded his correct responses he also excused his mistakes and did not seem to attend closely to the task at hand. In order to encourage attention to the task and to emphasize the importance of correctness of response, we introduced a reinforcement system on 1/13 in which M. received a red square of paper for every correct or task relevant response, and the teacher-examiner received a red square for every irrelevant, off-task or incorrect response that M. offered. M. was quite interested in "who was winning" and seemed to concentrate on the task, often testing out several alternatives and taking more time before submitting his final answer, particularly in encoding. His accuracy improved quickly and remained high, such that within two sessions he read "sam", "pat", and "pam" correctly almost every time. In addition, his decoding of the other words which he had been taught later reached high levels of accuracy by 1/28 and 2/8. After 2/8, we discontinued the special reinforcement since M. began to concentrate on the task and to decode taught words with a high degree of accuracy even when no reinforcement was supplied. Thus the reinforcement was necessary for only a short period of time, and apparently motivated M to attend to the reading task.

It is interesting to note that on 1/17, the reinforcement contingencies were altered in order to determine whether the effectiveness of the reinforcement was due to either (a) the need for clarification and concretization of the correctness of his own responses or (b) a competitive need to win. Thus, on 1/17, M received a red square of paper for correct responses or good guesses and a black one for wrong responses or silly guesses. M.was much less interested in this "game" than in the other one, and counted only the red papers. He was pleased by the accumulation of red papers but his accumulation of black papers did not bother him. At the end of the session, when the teacher-examiner suggested that he work harder next time in order to receive fewer black papers, M.said he would try to do better so that he could receive more red papers. He left after counting the red papers, without counting the black ones. In the following session, we reinstituted the original reinforcement "game" since M.was clearly more interested in the competitive aspect.

Evidence for Decoding and Encoding Strategies at the End of Period I(1/13-2/15)

Decoding. Although M's retention of taught words had improved considerably in January and the beginning of February, he had not developed a strategy for decoding unknown words. Indeed his responses often seemed random or minimally cued. For example, on 1/24 he read "tan" as ra, "pan" as ad, "tat" as /k/ and "nam" as /g/. On 2/8, he read "mad" as mat (a word he already had been taught to read) "at" as /m/, and "pad" as school.

Encoding. Between 1/13 and 2/15, M.was presented with only one generalizing word --nat-- to encode (on 2/15). While assembling the word he said: "/n/n", selected an n, then said: d or t, nattt,t, and selected a t, thus encoding "nt". This suggested that his minimal encoding strategy (evident as early as 12/3), in which he selected at least one appropriate consonant, had probably begun to develop into a more advanced strategy by the end of Period I.

* * * * * * * * * * * * * *

The discussion which follows traces M's performance and the strategies that emerged in his approaches to decoding and encoding tasks from the beginning of Period II on 2/18, when the "i" was introduced, through the final session of Period III held on 4/26.

Accuracy on Whole Words and Individual Components

Whole Word Accuracy in Decoding and Encoding

While M. never decoded an entire word correctly in Period I, by Period II he decoded 28% of his CVC generalization words with complete accuracy, and reached a level of 52% correct in Period III (see Table 1-M). As in decoding, M never encoded a word with complete accuracy in Period I. However, in Period II his level of encoding accuracy for whole words jumped to 65% and by Period III M was encoding words with complete accuracy 74% of the time (see Table 2-M).

Individual Component Accuracy

Decoding. In Period II, M was able to produce C_1 and C_2 at approximately the same level of accuracy (64% and 60% correct, respectively), while his production of the appropriate vowel lagged behind (48% correct; see Table 1-M). In Period III, the same general pattern emerged but the differences became more exaggerated: both C_1 and C_2 improved to a very high level of accuracy (97% and 100% respectively), while production of the correct V improved only slightly, to a 55% level of accuracy.

Thus, by Period III, M had developed a highly efficient strategy for producing the appropriate C_1 and C_2 components of a CVC, while by comparison his correct production of vowels remained at a low level. Indeed in Period III every error but one was attributable to the production of an incorrect vowel.

Table 1-M

Whole Word and Component Accuracy of CVC Decoding Words in Three Time Periods[a]

			Components of CVC									Whole word		
			C_1			V			C_2					
Time period	Total N		Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	No response
11/29-2/15	14	n	3	5	1	5	4	0	1	7	1	0	9[b]	5
		%	21	36	7	36	29	0	7	50	7	0	64	36
2/18-4/12	25	n	16	3	0	12	6	1	15	3	1	7	12	6
		%	64	12	0	48	24	4	60	12	4	28	48	24
4/15-4/26	29	n	28	1	0	16	13	0	29	0	0	15	14	0
		%	97	3	0	55	45	0	100	0	0	52	48	0
11/29-	68	n	47	9	1	33	23	1	45	10	2	22	35	11
		%												

Note: If a correct component was used, but in the wrong position, it was counted as incorrect in this analysis.

[a] The three time periods correspond to the introduction of the first three vowels (a, i, ω).

[b] Only three of the whole word responses were completely incorrect; these all occurred in the 11/29-2/15 period.

Encoding. In Period II, M exhibited a very high level of accuracy (95%) in selecting the appropriate C_1, but a lower level of accuracy for selecting both the V and C_2 (75%; see Table 2-M). While the C_1 was chosen with higher accuracy as early as Period II, M. correctly selected all three components with considerable frequency. The degree to which a strategy was already available to M. in Period I cannot be estimated reliably because of the limited number of opportunities with which M was provided for encoding CVC generalization words. However, some advantage for the first consonant was apparent even at that time and probably reflects a rudimentary strategy that M. used generally for consonants in various configurations besides CVC's. The subsequent emergence of C_1 as a component selected with 95% accuracy in Period II suggests that the general pattern in Period I is probably reliable. In addition, the very high level of accuracy for C_1, as opposed to the considerably lower one for C_2, suggests that the strategy involved greater attention to the consonant that occurred in the initial position - regardless of the particular consonant that appeared there. The identical consonant in final position was not encoded with the same degree of accuracy. Again, the availability of a strategy served as the crucial factor in M's ability to encode.

In Period III, accuracy for selection of C_1 remained at about the same, high level (93%) as before, C_2 improved to 89% correct, and V remained at about the same level as before. The final pattern that emerged showed that the V was selected with the lowest level of accuracy. As in decoding, M. had more difficulty encoding the vowel than either of the two consonants; however, the margin of difference between the V and the consonants was not nearly as great in encoding as in decoding.

Table 2-M
Whole Word and Component Accuracy of CVC Encoding Words in Three Time Periods[a]

			Components of CVC									Whole word		
			C_1			V			C_2					
Time period	Total N		Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	Omit	Correct	Incorrect	No response
11/29-2/15	8	n	4	0	0	1	2	1	2	2	0	0	4	4
		%	50	0	0	13	25	13	25	25	0	0	50	50
2/18-4/12	20	n	19	0	0	15	2	2	15	3	1	13	6	1
		%	95	0	0	75	10	10	75	15	5	65	30	5
4/15-4/26	27	n	25	0	1	20	4	2	24	0	2	20	6	1
		%	93	0	4	74	15	11	89	0	7	74	23	4
11/29-4/26	55	n	48	0	1	36	8	5	41	5	3	33	16	6
		%	87	0	2	64	15	9	75	9	5	60	29	11

Note: If a correct component was used, but in the wrong position, it was counted as incorrect in this analysis.

[a] The three time periods correspond to the introduction of the first three vowels (a, i, ꝏ).

Positioning Errors

While for some of the children the issue of correct ordering of phonemes and graphemes was an important one, for M.it was generally an irrelevant matter since he very rarely exhibited positioning errors in either encoding or decoding. Consequently, positioning errors were not considered in a separate analysis.

Overt Segmentation

Decoding

As indicated in Table 3-M, M.rarely used an observable segmentation or "sounding-out" strategy when decoding. Thus a comparison between accuracy rates when segmentation was and was not used could not yield reliable results. However, it is clear that M was able to achieve high levels of accuracy on C_1 and C_2 without overt segmentation.

In the ten cases when M did segment either C_1 or C_2, he not only sounded-out correctly but also produced the same, appropriate sound in the whole word response. Of the six times he segmented the vowel, he correctly sounded-out four times and produced the same, appropriate vowel sound in the whole-word response. In two cases, he sounded-out the vowel incorrectly, but in one of those cases produced the correct sound in his whole word response.

Encoding

Although M.tended to segment overtly more frequently when encoding than when decoding all words, he generally did not do so when encoding generalization words (see Table 4-M). It should be noted that when M. provided a letter name before selecting the letter, without providing the corresponding phoneme, the component was counted as segmented. Since M.had not been taught phonemes as separate entities and knew virtually none of the corresponding phonemes when he entered the study, it was not surprising that when segmenting a word he would label the parts with a letter name --the

Table 3-M

Frequency of Overt Segmentation and Relationship to Accuracy on Components of CVC Decoding Words in Three Time Periods[a]

					C_1				V				C_2			
		Total	No	Incorrect	Segmented		Not segmented		Segmented		Not segmented		Segmented		Not segmented	
Time period		presentations	response	segment.	Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct	Freq.	Correct
11/29-2/15	n	14	5	0	0	-	9	3	0	-	9	5	0	-	9	1
	%		36		0	-	64	33	0	-	64	56	0	-	64	11
2/18-4/12	n	25	6	1[b]	4	4	15	12	3[b]	2	16	9	1	1	18	14
	%		24		16	100	60	80	12	67	64	56	4	100	72	78
4/15-4/26	n	29	0	1[b]	3	3	26	25	3[b]	2	26	13	2	2	27	27
	%		0		10	100	90	96	10	67	90	50	7	100	93	100
11/29-4/26	n	68	11	2[b]	7	7	50	40	6[b]	4	51	27	3	3	54	42
	%		16		10	100	74	80	9	67	75	53	4	100	79	78

[a] The three time periods correspond to the introduction of the first three vowels (a, i,).

[b] V was incorrectly segmented once in the 2/18-4/12 period and once in the 4/15-4/26 period.

type of label he could rely on most readily. M. used the letter name without the phoneme once in Period I, six times in Period II, and once in Period III on unknown words; he frequently used the letter name in encoding words presented for at least the second time.

Table 4-M indicates that in Period I, he segmented only twice (once C_1 and once C_2). Both of these instances of sounding-out were followed by correct selection of the letter. In Period II M. sounded out C, 50% of the time; he selected the correct C whenever he did or did not segment in Period II. The only two cases of vowel segmentation in Period II were accompanied by correct selection of the vowel. In two of the three instances of C_2 segmentation in Period II, M. selected the correct C_2.

By Period III, segmentation of C_1 and C_2 had decreased but accuracy did not deteriorate as a result. The increase in V segmentation was not accompanied by an increase in V accuracy for segmented V's, nor were segmented V's more often correctly selected than non-segmented vowels.

Accuracy on Individual Consonants

Decoding

The consonant errors that M. made could not be attributed to confusion based on similarity of articulation, spatial orientation, or letter shape. However, systematic differences did emerge from a comparison of his performance on the first six consonants, presented between 11/29 and 3/11, and the last eight consonants, presented between 3/16 and 4/26.

After two to three months of exposure to the first set of consonants (s, m, p, t, n, and d), M. had not yet reached a high level of accuracy for any of these consonants (see Table 5-M) although he had met them repeatedly in the teaching words presented to him. In the final month of the study (from 3/16 to 4/26), eight new consonants (r, l, c, b, f,   , k, and h) were taught to M. in the context of whole words. M. rapidly mastered this new set of consonants and never made an error on any of them in a decoding generalization word, even when he was required to produce them during the same session in which he had been exposed to them in a teaching

Table 5-M
Correct and Incorrect Decoding of Consonants in CVC Generalization Words: General Accuracy and Changes over Time

		All sessions					Over time			
		Total	Correct		Incorrect		11/29-3/11		3/16-4/26	
Consonant	Date of introduction	N	n	%	n omitted	n substituted	n presented	% correct	n presented	% correct
s	11/29	14	8	57	3	3	6	17	8	88
m	11/29	13	7	54	5	1	10	40	3	100
p	11/29	17	7	41	4	6	11	9	6	100
t	12/10	20	11	55	6	3	8	13	12	92
n	12/16	17	12	69	4	1	6	17	11	100
d	12/16	13	5	38	4	4	6	0	7	71
r	3/16	7	7	100	0	0	-	-	7	100
l	3/16	12	12	100	0	0	-	-	12	100
c	3/16	8	8	100	0	0	-	-	8	100
b	4/15	5	5	100	0	0	-	-	5	100
f	4/15	3	3	100	0	0	-	-	3	100
Sh	4/22	3	3	100	0	0	-	-	3	100
k	4/22	2	2	100	0	0	-	-	2	100
h	4/26	2	2	100	0	0	-	-	2	100

word for the first time.

In addition, M.'s performance on the first set of consonants during the last month of the study (3/16-4/26) improved drastically. He used the m, p, and n with 100% accuracy, and the t, s, and d with 92%, 88%, and 71% accuracy, respectively. The d was produced with the least accuracy of all the consonants not only in the final phase but also in the initial phase (between 11/29 and 3/11). A large portion of the errors on the d were due to a confusion with t, the opposite member of the same voiced-voiceless pair.

M.'s rapid mastery of the second set of consonants, as well as his significantly improved use of the first set of consonants together suggest that at least as early as 3/16 M. had developed a strategy for using consonants in decoding tasks.

Encoding

As in decoding, a comparison of M.'s performance on the first six consonants with the last set of consonants did reveal systematic differences. Between 11/29 and 3/11, M. selected each of the first six consonants correctly between 50 and 71 percent of the time, with the exception of "n" -- which he always selected correctly (see Table 6-M). On the other hand, M. correctly selected 4 consonants (r, f, , and k) from the second set 100 percent of the time. He correctly chose four other consonants of that set between 67 and 86 percent of the time. The ʃ, taught to him in the final session, appeared in only one generalizing word, and M. failed to select in in his response. Thus M.'s performance on the second set of consonants surpassed that on the first set.

In addition, M.'s use of all the first six consonants (s, m, p, t, n, and d) improved considerably in the last month (between 3/16 and 4/26) except for the n, which remained at 100% accuracy. His improved selection of the first set of consonants and his highly accurate selection of the second set within a brief period of time both suggest that M. had developed a strategy for the use of consonants in encoding.

Accuracy on Individual Vowels

Decoding

In Period II, M. substituted an "a" and an "i" for each other in six out of

Table 6-M
Correct and Incorrect Encoding of Consonants in CVC Generalization Words: General Accuracy and Changes over Time

		All sessions					Over time			
		Total	Correct		Incorrect		11/29-3-11		3/16-4/26	
Consonant	Date of introduction	N	n	%	n omitted	n substituted	n presented	% correct	n presented	% correct
s	11/29	14	10	71	2	2	8	63	6	83
m	11/29	14	11	79	3	0	9	67	5	100
p	11/29	8	5	63	2	1	4	50	4	75
t	12/10	11	9	82	2	0	7	71	4	100
n	12/16	11	11	100	0	0	4	100	7	100
d	12/16	11	9	82	1	1	2	50	9	89
r	3/16	6	6	100	0	0	-	-	6	100
l	3/16	9	7	78	2	0	-	-	9	78
c	3/16	7	6	86	1	0	-	-	7	86
b	4/15	5	4	80	0	1	-	-	5	80
f	4/15	6	6	100	0	0	-	-	6	100
Sh	4/22	3	3	100	0	0	-	-	3	100
k	4/22	1	1	100	0	0	-	-	1	100
h	4/26	3	2	67	1	0	-	-	3	67
	4/26	1	0	0	1	0	-	-	1	0

eight unsuccessful attempts to produce the "a" or "i" -- the only vowels he had been taught up to that time. The same pattern of incorrect substitution of taught vowels for each other occurred in Period III in 13 of the 14 unsuccessful attempts to produce the "a," "i," ow" or "e."

The only vowel M. decoded with a rate of accuracy much above chance was the "a." This is probably attributable to practice or overlearning rather than the presence of a strategy, since "a" was the first vowel to wh[illegible] M. was exposed. Further support for the contention that M. had not yet developed a strategy for decoding vowels can be found in his performance on the new vowels introduced in Period III. He produced the /ow/ with only 44% accuracy, and never produced the /e/ correctly. If a strategy had been available to him, then the new vowels would have been absorbed more rapidly than they were. Indeed the ranking of the vowels from highest to lowest level of accuracy in Period III represents the same hierarchy from earliest to most recently introduced vowel (i.e., a, i, ow, e), further reflecting the effects of practice and the lack of a strategy.

M.'s tendency to omit a vowel in decoding was understandably infrequent, since through learning only whole words he had developed a set for producing at least a syllable when decoding, and a syllable necessarily includes a vowel. The only instance of a vowel omission in a decoding response of more than one phoneme occurred in Period II (on 3/16) when M. read "pin" as "pn." In Period III, he read "fill" as "full"; the vowel response was considered a schwa although it could represent the omission of a vowel or the use of a /u/. It appears that "i" may have had limited salience for M.

Encoding

In Period II, M. correctly selected the "a" 100 percent of the time and the "i" 69 percent of the time (see Table 8-M). His correct selection of the "a" in Period III dropped to 88 percent and that of the "i" decreased to 38 percent. However, he supplied the two new vowels -- "ow" and "e" -- with high levels of accuracy (83 percent and 100 percent, respectively). Apparently M. was able to master the new vowels rapidly, even though his performance on the "older" ones seemed to

Table 7-M
Accuracy of Vowel Decoding in CVC Words in Three Time Periods[a]

		Stimuli																											
		a							i							(ω)							e						
		Responses																											
Time period		a	i	(ω)	e	other	schwa omit	n.r.	i	a	(ω)	e	other	schwa omit	n.r.	(ω)	a	i	e	other	schwa omit	n.r.	e	a	i	(ω)	other	schwa omit	n.r.
11/29-2/15	n	6	0	0	0	3	0	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	43	0	0	0	33		36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/18-4/12	n	2	1	0	0	0	0	0	9	5	0	0	1	1	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	67	33	0	0	0	0	0	41	23	0	0	5	5	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4/12-4/26	n	5	0	0	0	0	0	0	6	3	1	0	0	1	0	4	1	4	0	0	0	0	0	2	2	0	0	0	0
	%	100	0	0	0	0	0	0	55	27	9	0	0	9	0	44	11	44	0	0	0	0	0	50	50	0	0	0	0
11/29-4/26	n	13	1	0	0	3	0	5	15	8	1	0	1	2	6	4	1	4	0	0	0	0	0	2	2	0	0	0	0
	%	59	5	0	0	14	0	23	45	24	3	0	3	6	18	44	11	44	0	0	0	0	0	50	50	0	0	0	0

---

[a] The three time periods correspond to the introduction of the first three vowels (a, i, ω).

Table 8-M

Accuracy of Vowel Encoding in CVC Words in Three Time Periods[a]

		Stimuli																											
		a							i														e						
		Responses																											
Time period		a	i		e	other	schwa omit	n.r.	i	a		e	other	schwa omit	n.r.		a	i	e	other	schwa omit	n.r.	e	a	i		other	schwa omit	n.r.
11/29-2/15	n	1	0	0	0	4	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	13	0	0	0	50	13	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/18-4/12	n	4	0	0	0	0	0	0	11	0	0	0	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	100	0	0	0	0	0	0	69	0	0	0	13	13	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4/12-4/26	n	7	1	0	0	0	0	0	3	0	1	1	0	2	1	5	0	0	0	1	0	0	5	0	0	0	0	0	0
	%	88	12	0	0	0	0	0	38	0	12	12	0	25	12	83	0	0	0	17	0	0	100	0	0	0	0	0	0
11/29-4/26	n	12	1	0	0	4	1	2	14	0	1	1	2	4	2	5	0	0	0	1	0	0	5	0	0	0	0	0	0
	%	60	5	0	0	20	5	10	58	0	4	4	8	17	8	83	0	0	0	17	0	0	100	0	0	0	0	0	0

---

[a] The three time periods correspond to the introduction of the first three vowels (a, i,).

deteriorate.

In Periods II and III, half of the incorrect attempts on words containing an "i" resulted in omission of the vowel in the final response. This may reflect a lack of salience -- rather than distinctiveness -- of vowels in general or the "i" in particular.

The Role of Meaning

Decoding

Accuracy on meaningful and nonsense generalization words. Of the 68 generalization words that were presented to Marc for decoding, 40 were meaningful, 12 were meaningless, and the remaining 16 cases were indeterminable since either the stimulus or response may or may not have represented meaning to the child.

M. tended to read a nonsense word correctly about as often as a meaningful word (25% and 30% of the time, respectively, see Table 9-M). Thus, the fact that a word was meaningful or not had no effect on the accuracy of M's decoding attempts. The reported similarity in accuracy levels was anticipated for two reasons. First, we expected accuracy to depend on the availability of a general decoding strategy which would be applicable to any word, regardless of its meaningfulness when read as an isolated word. Secondly, the child had no knowledge of whether the stimulus word was meaningful before decoding it correctly.

Table 9-M

Accuracy of Response in Decoding Meaningful and Nonsense CVC Generalization Words

		Decoding Response					
		Correct		Incorrect		None	
Stimulus Type	n[a]	n	%	n	%	n	%
Meaningful	40	12	30	22	55	6	15
Nonsense	12	3	25	5	42	4	10

[a] Of the total 68 decoding generalization words, 16 cases were indeterminable since either the stimulus or the response may or may not have represented meaning for the child.

Meaningfulness of error responses. An analysis of his incorrect responses strongly suggests that when decoding, M. tended to produce a meaningful response, whether the stimulus was nonsense or meaningful. When responding incorrectly, he gave a meaningful response to meaningful stimuli 68% of the time, and to nonsense stimuli 80% of the time (see Table 10-M). It is therefore apparent that M. expected the stimuli to yield meaning when decoded. It is possible that M. had developed an expectation for meaning prior to his experience with reading in this study. On the other hand, the fact that all words taught in the curriculum were meaningful, and that the majority of generalizing words presented and used in the study were meaningful, may account for M.'s expectation that decoding results in meaning.

In summary, the meaningfulness of a word had no effect on the accuracy of M.'s decoding, although his error responses gave evidence of his expectation that the stimulus word would be meaningful.

Table 10-M

Type of Error Response in Decoding Meaningful and Nonsense CVC Generalization Words

		Error Response			
		Meaningful		Nonsense	
Stimulus Type	n incorrect	n	%	n	%
Meaningful	22	15	68	7	32
Nonsense	5	4	80	1	20

Encoding

The only reasonable analysis of the role of meaning in encoding is an analysis of encoding accuracy for meaningful versus nonsense stimulus words since the meaningfulness of an encoding response is a matter of chance

It appears that M. encoded meaningful words with slightly less accuracy than nonsense words (61% and 75% accuracy, respectively; see Table 11-M). The apparent difference may actually be due to the much smaller number of opportunities presented to M. for decoding nonsense as opposed to meaningful words. Thus, as in decoding, the presence of meaning in the encoding stimulus does not seem to influence the level of accuracy to any considerable degree.

Table 11-M

Accuracy of Response in Encoding Meaningful and Nonsense CVC Generalization Words

		Encoding Response					
		Correct		Incorrect		None	
Stimulus Type	n[a]	n	%	n	%	n	%
Meaningful	28	17	61	8	29	3	11
Nonsense	8	6	75	2	25	0	0

[a] Of the total 55 encoding generalization words, 17 cases were indeterminable since the stimulus may or may not have represented meaning for the child.

This similarity in accuracy levels (for encoding meaningful and nonsense stimuli) was anticipated, since we predicted that the accuracy of encoding would depend on the use of a general strategy, applicable to any word, regardless of its meaningfulness.

The Development of Decoding and Encoding Strategies

Comparison of Decoding and Encoding Whole-Word Accuracy

The analysis of the rate of accuracy of decoding and encoding CVC generlizing words indicates that in both Periods II and III, M.'s encoding skills surpassed his decoding skills. This was particularly true in Period II, when his rate of whole-word encoding accuracy was 65% verus 28% for decoding (see Tables 1-M and 2-M). Indeed, the relatively high accuracy rate in encoding in Period II suggests that M. had already developed a rather efficient strategy for encoding unknown words while his decoding of unknown words was not yet guided by a systematic approach. The earlier emergence of a strategy for encoding is probably linked to the use of at least one consonant cue in Period I in encoding but not in decoding. In Period III, M.'s encoding skills improved and remained better than his decoding skills (74% versus 52%). However, his decoding ability had improved at a faster rate so that the margin of difference between the two skills diminished somewhat in Period III. Apparently, by Period III, M. had evolved a systematic approach for decoding as well, though the strategy had limited efficiency.

Consonants and Vowels

As noted earlier, in Period III every decoding error but one was attributable to the production of an incorrect vowel, and in encoding the vowel was the component selected with the lowest level of accuracy. Indeed, M.'s performance on vowels in Period III generalization words indicated that he had not yet developed a highly efficient strategy for using them. On the other hand, his ability to master rapidly the decoding and encoding of consonants introduced to him from 3/16 on, as well as the considerable improvement he demonstrated after 3/16 on the first set of consonants, affirmed the existence of a strategy that M. used for consonants.

The Development of a Strategy for Consonants through Segmentation

Much of the evidence for M.'s breaking out the phono-graphemic correspondences of consonants was apparent in his attempts to decode and encode words he had previously encountered. These instances were not included in the other analyses, which were based only on generalizing words to which M. had not been previously exposed. As early as the second session on 12/3, M. segmented the /p/ in "pam" before he misread it as "pat." In the following nine sessions (through 1/10) M. segmented the /p/ an additional eight times when encoding or decoding only the repeatedly-presented words "pat" and "pam" and never on a generalizing word. Aside from these cases of /p/, M. almost never segmented overtly through 1/13.

This pattern of segmentation, restricted to the single phoneme /p/ in familiar words, can be explained only as an attempt to develop a strategy on the basis of limited, previously acquired knowledge. That is, of all the letters in the early part of the curriculum, M. used the only letter name - letter sound correspondence he knew (p - /p/) according to the screening test results. In addition, M. used this approach only on "familiar" words presented repeatedly ("pat" and "pam"), and not on unknown material presented for generalizing. Both tactics suggest that M. segmented the /p/ because he was able to verify his choice against prior knowledge.

His willingness to segment other sounds was observed only in a particular setting -- when running his fingers over sandpaper letters that formed a word he undoubtedly knew, since the teacher-examiner had just read it for him. In this setting, M. could again verify his use of segmentation. When the word formed by sandpaper letters was not read to him, M. ran his fingers over the letters in silence and did not offer a guess. Apparently, at first M. could use segmentation only when able to verify it against known material. He could not use segmentation as a means for figuring out the unknown, i.e., not as a generalizing strategy.

By 2/15, however, segmentation began to serve as a generalizing strategy, although its use was primarily limited to the encoding task. The segmentation strategy, and the accompanying accuracy on those segmented phonemes, was apparent in the single generalization word "nat" which he encoded that day, and in his encoding of four other words listed below.

Encoding Stimulus	M.'s Oral Response	Assembled Word
sap	/s/ c (selected c) p (selected p)	cp
pad	p (selected p) a (selected a) /d/ (selected b)	pab
rat	/r/ (selects r) rat /d/ d ? t (selected d)	rd
pan	p /p/ (selected p) pannn	p
nat	/n/ n (selected n) d or t? nattt, t (selected t)	nt

Thus, on 2/15 M. tended either to segment the phoneme from the word presented auditorily, say the letter name, or do both for the consonants.

On 3/1, the same encoding pattern was more consistently observed: of the 14 CVC's to be encoded that day M. segmented at least one consonant sound or letter name in eight cases, usually selected both consonants correctly, and often omitted the vowel.

The encoding attempts on 3/1 are listed below:

Encoding Stimulus	M.'s Oral Response	Assembled Word
dim	d d (selected d) (selected o,c)	ocd
sit	s (selected s) t (selected t)	st
tip	/t//t/ /p//p/tip (selected t and p)	tp
pam	p p (selects p) a (selects a) pp/p//p/p (selected m)	pam
pim	/p/ (selected p) (selected m)	pm
mit	/m//m/ (selected m) /it/t/ (selected t)	mt
dit	(selected d) /t/ /t/ t (selected t)	dt
nip	/p//p/ nip (selected n and p	np

While he frequently segmented or used the letter name in encoding, he never used the letter name and segmented only once among the numerous attempts to decode both new and familiar words on the same two dates (2/15 and 3/1). Apparently M. used the letter name as an intermediary cue between the sound and symbol, which especially facilitated selection of the appropriate grapheme in encoding. Naming the letters could not have the same utility in decoding as in encoding, hence the specificty of its use. In the next session (3/8), M. continued to segment consonants or use the letter name and select the correct grapheme.

As reported earlier, by 3/16 M. had achieved a high degree of accuracy in dealing with consonants. This is probably the finished product of a strategy that evolved through segmentation of sounds which were then associated with letter names and finally with symbols. M.'s performance on the screening test when readministered to him on 3/4, showed that he had learned to associate the sounds of consonants with all the letter names and graphemes that appeared in any word he had been taught up to that time (p, s, t, d, m, n, th, s). He could produce the /a/ for "a", but could not give a sound for "i." In addition, he was now also able to produce the sounds of some consonant graphemes to which he had not been exposed in the study and had not known prior to the study (r, l, k, and g). He also produced the sound /w/ for y, /d/ for w, and /s/ for c; these examples demonstrate his grasp of a rule for deriving the sounds from the letter names. Indeed, he produced the /s/ for c and the /w/ for y on the original administration of the screening test.

In summary, M. relied on both segmentation and knowledge of letter names to break out sounds of words and associate them with graphemes. He did so primarily with consonants, when encoding.

The Absence of an Efficient Strategy for Vowels

At the same time that an encoding strategy began to emerge (on 2/15 and 3/1) for dealing with consonants, M. tended to omit the vowel in encoding both familiar and generalizing words. In addition, M. segmented the vowel only once in encoding on those two days, and even then did not isolate it as a single phoneme. In decoding, M. tended to give at least a syllable as a final response, which thus included a vowel.

However, M. once omitted the vowel in decoding a familiar word on 3/1 -- he first misread "tim" as "tm," and then read it as "time."

At the beginning of the session on 3/8, M. continued the same pattern of no vowel segmentation in encoding or decoding, and omission of the vowel from the encoding response. He did, however, segment the /i/ in the word "in" correctly, and then encoded the word as "aip." Perhaps the vowel was more salient for him when it appeared in the initial position. After several corrections, M. began to include an "i" in the middle position of CVC's, though he still did not segment the vowel out loud or use it's letter name. M. had probably developed a set for placing the "i" in the middle of a CVC, though it still was not actually salient for him.

The tendency to omit the vowels or use them incorrectly seems to stem from three factors: 1) their lack of salience; 2) the lack of resemblance between the letter names of vowels and their short sounds; and 3) the difficulty in isolating them from bordering consonants (when they do not appear in initial position). Evidence for their lack of salience has been shown in M.'s failure to segment the vowel in decoding and encoding, in his failure to select the vowel in encoding, and in his assigning of the schwa to the vowel when running his fingers over the sandpaper letters of a word he knew. The compounded difficulty of isolating the vowel when actually segmented as part of a syllable was seen once on both 3/1 and 3/8: M. was able to segment the vowel in encoding, but only as part of a VC or CV syllable. After 3/16, M. did segment the vowel several times as an isolated phoneme when encoding unknown, generalization words.

While overt segmentation played an important role in the evolution of an encoding and decoding strategy, it did not correlate with accuracy on components of CVC generalization words over all the sessions in either encoding or decoding. Apparently, M. had relied on overt segmentation briefly in order to develop a fairly comprehensive strategy in encoding, but once developed, he did not need to segment in order to ensure accuracy.

Appendix A - M
Decoding Error Responses to Meaningful and Nonsense CVC Generalization Words

Meaningful words				Nonsense words			
	Response type				Response type		
Stimuli	Meaningful	Nonsense	None	Stimuli	Meaningful	Nonsense	None
pam	sharla			pap	tickle		
mat	sam			tas	pat		
tan		ra		tat			x
pan	add			nam			x
man			x	pim	tim		
sad			x	dit			x
mad	mat			min			x
pad	school			mip	man		
sit	ass			tid		nid	
did	tip						
pit			x				
sip			x				
pin		p'n					
nit	dint[a]						
rip	rap						
lip		alp					
tic	tac						
rib		irb					
fill	full						
nan			x				
s(a)t	sat						
r(a)t		rit					
ship		sh(a)p					
sick	cat						
ten	tan						
hil	hal						
hen		han					

---

[a] Since M. pronounced "didn't" as "dint," this response was considered to be a meaningful one.

Appendix B - M.
Encoding Error Responses to Meaningful and Nonsense CVC Generalization Words

Meaningful words		Nonsense words	
Stimuli	Encoding responses	Stimuli	Encoding responses
sat	(none)	sas	spc
pass	psm	nis	nof
tap	(none)		
map	mns		
sit	st		
tip	tp		
tack	tk		
pill	(none)		
cab	kad		
coal	col		
dish	dsh		

J

Introduction

On the screening test J. produced the name of 17 graphemes (4 vowels, 13 consonants) and recognized an additional 3 letter names (1 vowel, 2 consonants). He produced 14 phonemes (1 vowel, 13 consonants) and recognized an additional three (1 vowel, 2 consonants). His segmentation of initial vowel and consonant phonemes was usually correct, although he could not segment any medial or final phonemes. He was able to blend only one word (which happened to be one of the few words he said he could read); he included the initial phoneme of the stimulus in his response half the time, the final phoneme the remainder of the time. He read three sight words, stating he had learned them on "Sesame Street," but read one of his "known" words (i.e., words he had volunteered) incorrectly, and was poor on encoding.

J. indicated some difficulty with several of the concepts presumed to be necessary on the reading task. While he understood the difference between "right" and "left", he incorrectly matched an upside-down word to a standard (a mirror reversal) in one case, and a word printed backwards (i.e., "evig" for "give") to another standard (an order reversal). He believed that letters and words are the same thing and could not identify auditory word boundaries. He also made the comments that the head is necessary for reading ("to see") and a pencil necessary for writing, rather than mentioning letters or words.

J. had a number of major problems that were manifested in our sessions together. He showed little progress in the learning tasks at any time. This is probably attributable to both perceptual and behavioral deficiencies: his performance indicated a great deal of difficulty with many of the tasks presented to him, performing successfully only when they were broken down into minute components. He also may have been constricted by some sort of "block" against reading; he wished to "remain a baby" and identified reading as a task for older people, a symbol of maturity which he did not want to attain. As a result, his attention to the task was often minimal. At one point in the year

(1/17-2/7) we made use of token reinforcements in the hope that it would increase on-task behavior. Instead, J. found this to be anxiety-provoking; as this system was only minimally beneficial, it was abandoned after only a few sessions. For these reasons, we cannot perform the in-depth analysis, which was appropriate for some of the other children, on J's data. Instead, a brief narrative discussion which highlights his more prevalent error patterns follows.

Treatment Implementation

J. indicated reasonable phonemic knowledge but only minimal sight word knowledge; the decision was made to place him in the part-whole approach (P-W). J. received instruction on only six consonants (s,m,p,t,n,d) and three vowels (a, i, u) during our 34 sessions together. While he easily remembered the phono-graphemic correspondences of isolated graphemes, he did not acquire any strategy with which to apply these successfully in decoding or encoding.

Decoding

A characteristic response made to generalization words by J. was to fail to emit a whole word response, although he often sounded out the individual phonemic components (See Table 1). Of the 51 CVC "generalization" words with which he was presented, only eight (16%) were read correctly (e.g. "sam" on 1/24). The 25 words to which he gave some kind of whole word response were usually at least partially correct. He included the initial consonant in his response (e.g. "tap" was read as "tiger") fifteen times, and included the final consonant in his whole word response fourteen times (e.g. "sam" was read as "map).

No improvement in his decoding accuracy was evident over the course of the year. In earlier sessions he seemed to pay more attention to the initial part of the stimulus word than the final part; in later sessions, however, the reverse occurred, so that he got the C_2 correct on 9 of 11 words and the C_1 correct on only three of the 11 words which were decoded, albeit incorrectly. We can surmise that J. was beginning to develop at least a minimal strategy in

Table 1 - J
Whole Word and Component Accuracy of CVC Decoding Words in Two Time Periods[a]

Time period	Total	N	Components of CVC C_1 Correct	 Incorrect	 V Correct	 Incorrect	 C_2 Correct	 Incorrect	Whole word Correct	 Incorrect	 No response
11/15	26	n	12	4	13	3	5	11	4	16	6
1/13		%	46	15	50	12	19	42	15	62	23
1/17	25	n	3	8	7	4	9	2	4	18	3
3/28		%	12	32	28	16	36	8	16	72	12
11/15	51	n	15	12	20	7	14	13	8	34	9
3/28		%	29	24	39	14	27	25	16	67	18

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[a] The two time periods were divided to get equal numbers of words in each.

that he had shifted his attention to that component (C_2) on which he was having the greatest difficulty; however, it is clear that this shift occurred prematurely in that he dropped in accuracy on the C_1.

J. indicated a slightly greater tendency to emit no whole-word responses in later sessions. His resistance to the reading task became so strong that after 3/28 no "new" words were presented. Instead, we concentrated on some of the more enjoyable aspects of the reading task; these included an acting game and reading stories aloud.

One task was developed for J. to check on his attentional pattern to different components. When presented with several word cards (e.g. hat, fish, pin) and asked to match them to pictures, J. was highly successful when the initial consonants were different (i.e., "h", "f", "p"). When asked to match on the basis of final consonant, however, he was considerably less successful (e.g. "cat", "candle", "cow") and was correct only by chance. It was clear that, for J. only the initial consonant was consistently salient.

Encoding

In earlier sessions, J. was seldom, if ever, accurate, even on those words to which he had been repeatedly exposed. Only in later sessions did he encode with any accuracy, getting only the C_1 without prompting.

Additional Comments. As has been noted, J. was seldom successful in either decoding or encoding. However, when certain tasks were broken down into smaller units he was often successful. For example: while J. had a great deal of difficulty simply blending two isolated bits, if requested to elongate those bits (e.g. /i/+/n/ = iiinnn) and then shorten the result (e.g. iiinnn= in) he could do so. Unfortunately, he could not generalize by skipping the elongation step and progress to real blending.

An attempt was made to increase his encoding by breaking that task down to components also. Using two phonemes on which he had demonstrated blending he was directed to select the appropriate graphemes (e.g. asked to blend /i//n/, if he could arrive at "in" he was then requested to select the /i/ and the

/n/ and place them together). Even at this level, however, J. was unable to decode the result (i.e., "in"), even though he had accurately blended it a moment previously. This seems to suggest real auditory-visual integration problems.

Finally, J. was fascinated by some aspects of our sessions. He enjoyed playing games with certain graphemes (e.g.,"ω") even to the point of attributing animate qualities (e.g. "the ω is happy today"). He would have been very pleased if we had been content to remain on the level of treating the letters like toys and asking of him only very simple things (e.g. tell us words that begin with a certain phoneme). He was very clear about his inabilities, and often stated what was easy ("I like to just say what these (letters) are named") and what was difficult ("I don't know how to put them together"). His failure to improve was accompanied by mounting frustration and gradual withdrawal until we disbanded all testing and opted for a more games-oriented approach.

KL

Introduction

On the screening test, KL indicated an enthusiasm about reading and demonstrated an understanding of the requirements of the task, although he was unsure of its function (he thought reading would make him strong, and that others want children to read because it will keep them quiet). He performed satisfactorily on both visual matching tasks (letters and words). It was his belief that a written word could mean a variety of things and that pictures are a better means of representing ideas. (A favorite page in one of his books had only pictures and lacked words.) He had no skill in recognizing word boundaries auditorily or visually. He seemed clear about the separate functions of numbers (you count with them) and letters (you "talk" with them). While he was able to assemble his first and part of his last name (deleting one vowel in the latter), he believed that his first name could say his whole name as well as be someone else's name when that began with the same letter.

KL knew the names of all but three graphemes (m,d and q) and recognized all but one (d). He produced the sounds of 14 letters (13 consonants and the "a") and recognized the sounds of an additional nine (6 consonants and three vowels). He was only able to segment initial consonants; only once did he segment an initial vowel, and he was unable to segment any medial or final phonemes. While correct on only two of nine blending problems, his errors usually included most of the phonemes initially presented (e.g. /h//a//m/ = "hatchet"). He was able to read six of the 18 Durkin words presented and made close guesses on the others. He also made good attempts in encoding both Durkin list words and words he volunteered.

Given KL's strong knowledge of sound-symbol correspondences and his knowledge of a number of sight words, we placed him in the mixed method (MM) which emphasized both kinds of information. A rather clumsy child, he had a great tendency to be distracted and off-task which presented problems throughout the year. We suspect him to be a somewhat "impulsive child" since he rattles off incorrect answers rapidly without sufficient thought, although he indicated an above-average intelligence on the Peabody Picture Vocabulary Test. At one point in the year (1/24-2/7) we instituted a token reinforcement system to attempt to increase his attention to the task. In the initial phase he was reinforced (with bits of colored paper as tokens), for each correct answer or close guess. This only worked for one session, so two variations were tried: 1) he was reinforced for correct answers and the examiner was "rewarded" with a different colored bit of paper when he made an error or was silly; 2) he was reinforced for correct answers and penalized for incorrect or silly responses by the removal of one of his tokens. We discontinued the use of this system on 2/7 when we realized that it was anxiety-provoking and only minimally effective; he was glad to see it end.

KL.was an outstanding storyteller. Two observations in regard to this are important. First of all, he used storytelling as a means of avoiding tasks he thought were too difficult, or that he was unable to do. Occasionally his stories seemed to be related to the task at hand (e.g. telling a story about parents, when "dad" was the teaching word). More often they were simply a diversionary tactic to avoid decoding or encoding. (Because he was an extremely entertaining child, it was often difficult to suppress this behavior successfully.

In addition, KL.was fascinated by "super heroes," particularly Batman, Robin and Superman, and enjoyed talking about them constantly. (One of the few purposes he saw for reading was to be able to read his comic books.) He had been taught these words (by his father) and knew the letter names of all and the sounds of most of the component graphemes of the three words. We attempted throughout the year to capitalize on his knowledge of these "organic" words, using them for instruction and comparison. As will be discussed later he had only minimal success in generalizing his specific phono-graphemic knowledge from these letters to other, less familiar, configurations.

KL. was unsure of several concepts that are important in the reading task. He did not differentiate between "beginning" and "end" and thought that rhyming words began with the same letter rather than end with similar sounds (this latter confusion precluded his taking advantage of "family" configurations) While he understood the difference between right and left and thought that reading should begin at the left he was unable to apply this to his decoding or encoding; as a result, many reversals occurred.

Treatment Implementation

KL. was presented with ten graphemes during the 37 sessions, eight consonants (s,a,p,t,m,n,d,r,c) and two vowels (a, i); he was also taught a number of sight words.

As has been noted in the Preliminary Report, both content and process information were to be made available to children in the mixed method (MM), but not for the same material. For example, the child might be explicitly instructed on the sound equivalent of one grapheme but would have to deduce the sound equivalent of some other grapheme which was taught only in the context of a sight word.

Theoretically this would have made it possible to determine which mode of presentation was most effective for a particular child. Unfortunately, KL. had great difficulty in mastering whole words and in evolving a blending strategy to apply to new words composed of "known" graphemes.

We could determine only that neither approach was helpful to KL. and were forced to abandon the structured curriculum in our search for productive techniques. We began to rely on more directed instruction than had been originally intended. As a result, the detailed analysis performed on several of the other children was not appropriate in KL's case and a more narrative discussion of KL's difficulties and idiosyncrasies follows.

Encoding and Decoding Patterns (11/15/76-2/7/77)

Throughout this period KL. did not decode or encode with any consistency and made many errors. These errors showed no consistent pattern. He was as likely to cue on the end of a CVC configuration as the beginning. An example from one of the early sessions illustrates this difficulty; having been taught the bigram "sa" and asked to add on "p" to make "sap" he read it as "pand". When he made a second attempt he responded with "sam"; several additional attempts were made with no greater success.

The response of "pand" to "sap" is an example of an error type which occurred frequently. KL. often added one of the two nasal conconants (m,n) or substituted one of them for another consonant in both his decoding and encoding responses. Repeated examples abound in every session: "pat" was read as "snap", or as "tant", "tas" as "tam", "at" as "ant", "sat" as "tamp", etc. In his encoding, a similar pattern was observed: for "sap" he arranged "spm", for "tap" he made "tam", for "tad" he arranged "tm" then "tam". However, when he was to encode or decode words that actually contained "m" or "n" as a component he was likely to eliminate it: he encoded "pan" as "pat" and decoded "tan" as "tap". It is unclear whether the insertion of the "m" and "n" was a result of the nasal quality in his speech, he used the "m" of which he was certain, in place of consonants about which he felt unsure. KL, also seemed to cue on his own errors. When an erroneous response had been made, he would often attempt a second response based on his initial response, instead of rechecking with the visual stimulus. (e.g. "pas" was decoded as "pat" then "tam").

Encoding and Decoding Patterns (2/10/77-4/28/77)

Decoding - Until 2/10 KL. demonstrated little progress in developing a successful decoding strategy. On 2/10 a consultant assessed his auditory skills to ascertain if a decoding strategy could be taught to him that was based on those skills which he could demonstrate. The assessment of auditory skills indicated consistent difficulties with three-bit blends (e.g. /c//a//t/ =cat), and no difficulty with syllabic blending (e.g. /win//dow/= "window") or with /C//VC/ two-bit blending (such as /t//ap/= tap). The primary difficulty he seemed to have was in actually creating the VC bigram. He consistently included the schwa (ə) in his blending response, thereby extending the word (e.g.,

/a//p/ = "apuh"). A decision was made to proceed with a family approach where only one VC bigram at a time would be used in a series of words which differed only in the initial consonant. KL was taught to attend to the bigram (e.g./at/) and then add on the initial consonant (e.g. s /ap/ = sap). Using this highly structured, somewhat cumbersome method, KL's decoding greatly improved from then on. While he never achieved a consistently high decoding accuracy rate, his performance indicated that the procedure of attending first to the VC bigram then the C_1 was not always necessary, so that he could skip a few steps and move more rapidly to uttering a whole word response (e.g., instead of proceding /a//p/=ap, /t/ /ap/=tap, he could, at times, simply sound the bigram /a//p/=ap,tap).

Encoding. Previous to 3/28, KL had great difficulty with the encoding task; although he occasionally got all three components correct, he usually placed the vowel at the end in his response (e.g. "sam" = sma). Since he persisted in using letter names rather than sounds in his encoding the decision was made to encourage this practice of "spelling out". On 3/28 he was asked to spell "mat" before encoding and he named the "t" then "m" then "a" and encoded "mta." He was also asked to encode "mit". When asked for the first letter he responded "m" when asked for the second letter, he responded "t" and finally got the "i", indicating his customary difficulty with the vowel. This spelling aloud procedure proved to be moderately successful and indicated that he was beginning to generalize from knowledge of his "organic" words. On 4/4 he used the components of "man" to spell those of "mat"; i.e., when asked for the first letter of "mat" he said he needed the first one in "man", m, and did the same thing for the second letter "a". It would appear that KL needed the "label" that the letter name (and not the phonemic equivalent) provides.

Blending and Segmentation Skills

KL demonstrated handicaps somewhat unique to the beginning reader he was able to blend reasonably accurately only when the examiner produced the phonemes, and made many more errors when he produced the phonemic bits himself. Even when he could blend, however, he was more successful if only an auditory stimulus was present. Visual presentations hampered his blending/decoding to such an extent that an auditory-visual integration problem was suspected. While never comprehensively assessed for general learning disability, the possibility of some disabling condition needs to be considered. Alternatively, his multiple difficulties might be a function of a developmental lag; the project team made the recommendation that he be adequately tested by competent diagnosticians.

With these rather negative conclusions the comment must still be made that KL did show some progress throughout the year. On the second administration of the screening test (in February) he demonstrated additional phonemic knowledge that had been acquired elsewhere as well as improved segmentation and blending skills. In addition, during the final two sessions he was able to read words which he had never remembered in any of the numerous session, in which they had previously been presented.

Introduction

On the screening test, KM. demonstrated extensive knowledge of letter names, naming every letter correctly with the exception of h, which she called b, and q, which she called p. Her knowledge of sound-symbol correspondences was also very strong, but limited to the consonants: she correctly produced 17 of the consonant sounds, recognized an additional two (h and y), but had no knowledge of the sounds of x and q; she could neither produce nor recognize the corresponding sounds of any of the five vowels.

KM's blending skills were well developed but her ability to segment was less adequate. She could segment the initial sounds of auditorily presented words, but showed minimal ability to segment final sounds, and no ability to segment middle sounds. She was able to read 15 of the 18 words from Durkin's list that appeared on the screening test, and, indeed, responded affirmatively to the question: Can you read?

While KM. exhibited an ability to read many words, her ability to encode words lagged behind considerably. She made many encoding errors on the same words she was able to read correctly. In addition KM. mentioned several words she could read from a book she had. When the word itself and another word with a similar configuration were placed in front of her simultaneously, she read them both as the same word (e.g., ball and doll were both read as "doll"). The slightly different configuration did not affect her processing of the words. In addition, she read the word "bear" as bed.

Her poor encoding as compared with decoding ability, combined with her ability to rely on a visual gestalt in order to recognize words, suggested that KM. had a large sight word vocabulary but had not yet evolved a full decoding or encoding strategy.

KM. is a very well mannered child and was always "on task" during our sessions with her. She participated in the sessions with great seriousness, though her regular classroom behavior was quite playful and noisy. KM. derived unusual enjoyment from reading stories and commented on the screening test that the reason she reads is because she likes it - which is undoubtedly true.

Treatment Implementation

Since KM. demonstrated knowledge of sound-symbol correspondences as well as a whole-word strategy for recognition of words, she was placed in the mixed-method. Although KM had some difficulty in distinguishing among similar-looking words in isolation and, therefore, appeared to have a limited decoding strategy on the screening test, it became clear after several sessions that she could read words previously unknown to her if they appeared in the context of a sentence or story rather than as isolated words.

As a result, KM. entered the experiment with a fairly well developed decoding strategy that did not evolve through exposure to the experimental treatment. A large number of sessions were devoted to experimentation with different materials in an effort to pinpoint the strengths and weaknesses of her particular decoding strategy in order to account for the differences between her decoding performance on words in isolation versus in context. In addition, her encoding ability was evaluated. The remainder of the sessions were devoted to correction of the weaknesses in her decoding strategy as well as observation of the evolvement of an encoding strategy.

Decoding Isolated Words

Between 11/29 and 3/11, KM was able to decode CVC meaningful and nonsense words presented to her in isolation with approximately 60-70% accuracy. An analysis of her 92 incorrect decoding attempts reveals a very clear pattern. In 50 cases of errors (54%) only the vowel was read incorrectly. For example, "nat" was read as not, "pin" as pon, and "mip" as map. In another 20 cases (22%), only the C_2 was misread. The only instances when just the C_1 was misread (2% of the time) occurred when "din" was read as "tin," and "fad" as "rad." Of the remaining 20 errors with more than one component incorrect, only two involved an incorrect C_1 ("tid" to "dib," and "fap" to vip"). The other 18 involved both a V and a C_2 error.

The predominance of vowel errors must be attributed, at least in part, to their lack of salience when they are bounded by two consonants, rather than to a total inability to supply the correct sound. Evidence for this can be found in KM's decoding of words that begin with a vowel. In every case, KM. attended to the vowel by beginning her response with the correct vowel sound whether or not she decoded the entire word correctly. Below is a list of her errors on words beginning with a vowel.

Stimulus	Response
only	owl
empty	elp
octapus	oscar
afraid	after
[illegible]f	[illegible]v
[illegible]k	[illegible]g
around	animal

KM's performance on the consonants, though much better than on the vowels, still indicated a particular pattern of error. Of the 22 errors she made on consonants, 12 (55%) involved substitutions of the inappropriate member of a voiced-voiceless pair. The pairs involved were: t-d, f-v, s-z, and c,k-g (hard c and hard g). The articulatory confusions may well be the result of KM's lack of overt segmentation in decoding. That is when processing the word silently, prior to producing her decoding response, she may actually position the articulators appropriately for the /t/ sound, but the same positioning of articulators is appropriate for the /d/ sound as well; they are only distinguished when produced out loud, through the presence or absence of voicing.

While KM. could not use semantic cues in encoding in the way she could use them when decoding words in context, she did show a slight tendency to misread a nonsense word as meaningful more often than as nonsense. Of the 31 nonsense CVC's incorrectly decoded, 18 were read as meaningful words (58%) and 13 as nonsense (42%).

In summary, when decoding isolated words, KM relied heavily on the consonants to achieve accuracy and was somewhat guided by a tendency to produce a meaningful response. Her minimal attention to the vowel when it occurred in non-initial position must be explained, at least in part, as a lack of salience.

Encoding Isolated Words

Only a small portion of the time spent with KM.was devoted to encoding exercises. Between 11/29 and 3/11, she encoded 39 CVC words out of which 26 were incorrect (33% rate of accuracy). As with the decoding task, the predominant error involved the vowel and accounted for 15 (58%) of the errors. In six cases, only the C_2 was incorrect (23%), and in one case only the C_1 was incorrect (4%). Three of the seven consonant errors involved selection of the inappropriate member of a voiced-voiceless pair (either the t-d pair or the c,k-g pair).

Decoding Words in Context

While KM.showed a level of accuracy of about 60-70% in decoding isolated CVC's, she showed an ability to read end-of-first-grade books with relative fluency. Indeed, she was able to read a book at that level printed in i/t/a; although many of the symbols had never been taught to her. An analysis of her performance on two stories showed an 84% level of accuracy based on a total of 184 words. It should be pointed out that this percentage was based on all words, including many with sophisticated configurations rather than just CVC's.

Some words that KM.had read correctly in the context of a story were later presented to her as isolated words. Her errors are listed below. The same tendency to pay maximum attention to the initial letter (all consonants below) and often to misread only the vowel characterized her responses when the words appeared in isolation. For her, context was a powerful aid since she read all these words correctly in the story.

Stimulus	Response
party	part
break	back

Stimulus	Response
broke	brack
made	met
begin	bug
made	mad
get	geet, get
got	get

The difference in KM's ability to read words in context versus in isolation can be explained by the use of cues which not only enhance her reading ability but also compensate for the weaknesses of her decoding strategy. If the reader has no reason to suspect that an isolated word will be meaningful or nonsense, then it offers only grapho-phonemic cues to the prospective decoder. However, a word that appears in the context of a sentence, which may be in a story, can be decoded with the aid of many more cues. The context provides semantic cues which alert the reader to supply a word that would be appropriate in terms of the meaning of the sentence, and, if available, of the story and pictures. In addition, the context provides syntactic cues, signalling the reader to supply a word that will be appropriate in terms of part of speech, verb tense, verb inflection, and number (singular or plural). For example, when the word "sat" appears in the sentence: "He sat." the reader can figure out without attending to the vowel, that the appropriate word would be sat and not sit on the basis of the syntactic context and knowledge of the consonants.

The errors that KM.made in reading two stories on 1/13 and 1/24, are analyzed below in order to demonstrate her use of context cues in decoding. Of the 31 errors that she made 14 (47%) were appropriate both semantically and syntactically in the context of the story. In several cases, only the vowel was misread.

Stimulus	Response
only	loneliest
cheese	covers, chips
was	whose
mouse	mice
flew	fell
fooling	feeding
go	get
bag	bed
knew	knows

Stimulus	Response
space	special
thought	told
helmet	hat
chunk	kiss
smell	saw

Another six errors were appropriate syntactically but not sematically.

Stimulus	Response
spot	slot
shut	sneak
eyes	ear
climbed	tumbled
arms	animal
days	boys

Two errors "get" for "got" and "go" for "going," were semantically but not syntactically appropriate. There were an additional four errors which were neither semantically nor syntactically appropriate; all of the errors, however, exhibited a maximum reliance on grapho-phonemic cues and three resembled the same error pattern observed when decoding isolated words where the vowel is minimally salient; the fourth simply omitted a middle consonant.

Stimulus	Response
shut	shout
smell	small
well, well	will, will
fast	fat

The remaining errors in context were not clearly classifiable.

The few errors that involved words beginning with a vowel again demonstrated KM's attention to vowels when they occurred in initial position.

Stimulus	Response
eyes	ear
earth	edge
arms	animal
all	awe